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VICE-ADMIRAL SIR J. EDMUND COMMERELL, V.C., K.C.B., in the Chair.

THE INTERIOR ECONOMY OF A MODERN MAN-OF-WAR.

By Lieutenant CHARLES CAMPBELL, R.N.[1]

WHEN first asked by the Council if I would undertake the task of writing a paper on the interior economy of a man-of-war, it occurred to me that it was a subject upon which there might be a very large difference of opinion, and with which every naval Officer must be familiar. The answer was, that there was so much the more reason for placing the opinions arrived at by an individual before a number of members of the profession gathered together for the purpose of discussing the subject, so that they might be combated, thoroughly sifted, and some definite conclusion arrived at.

Of one thing my experience has convinced me, that every naval Officer does his utmost for the honour and welfare of the ship in which he is serving; and this paper is only intended to humbly assist in establishing and ventilating the best means of conducting the interior economy of a man-of-war, and the best direction for the energy of her Officers and men, so that she may become a credit to them, and to that Service in which we are proud to serve. The greater part naturally consists of what is actually going on in all ships from day to day, and I claim no originality for what I have only tried to make accurate. I have again, as in former papers, followed the idea of Montaigne, and shall place before you a nosegay of culled flowers, bringing nothing of my own but the thread that ties them.

A man-of-war—it matters little of what nationality—has become, even to those who find no difficulty in following the rapid changes in naval architecture, a complex machine; and there is little happening at the present time to persuade us to believe in the doctrine of finality as far as a type of shipbuilding is concerned, or to predict that the men-of-war of the future will be more simply constructed. But, while more engineering skill will be required for maintenance and

[1] Now Commander Campbell, H.M.S. "Alexandra."

preservation, every step that is taken lessens the necessity for the employment of seamen of the old school, for drills and exercises aloft, to keep them efficient, and, in fact, for any exercise that is not actually connected with the fighting powers of the ship. That is to say, in the sailing days, a great part of the training had reference to the safety of the ship under sail, beating off a lee shore, reefing, furling, &c., in heavy weather; whereas now, even a masted ironclad, if it comes on to blow hard enough to endanger the ship, she is generally placed under steam and fore and aft storm-canvas, bow to the swell, and so rides out the gale.

The real difficulty in dealing with the general consideration of the interior economy of a man-of-war is the diversity of class and the varying conditions of service, together with the fact that we have not got to train men for any special class, but for the general service of the whole fleet. On the one hand we have the mastless turret vessel, on the other the cruizing corvette. Added to this is the fact, that we are in a tentative and changing stage; and a review of the past tells us that we are likely to continue in that stage. Therefore in the same manner that the speed of the fleet is regulated by the slowest ship, so inversely the quantity of seamanship in the seaman of to-day and of the future must be regulated by the ship that requires the greatest amount of such knowledge. The interior economy of a man-of-war must always be first considered with reference to rendering the ship a perfect fighting machine; next as to the safety; and, lastly, as to the cleanliness, preservation, and outward appearance of the ship.

First, a fighting ship; 2nd, a smart ship; and last, but not least, a clean and well-kept ship.

The same rules govern the fighting exercises of every ship of war, no matter what her class or build: and they are clearly laid down in the Gunnery Manual. They are carried out by systematic instruction at intervals to the whole ship's company, in the preparation for battle, daily, and continually to smaller bodies of men in the details of heavy gun, rifle, cutlass, and pistol exercises, and small-arm companies. The cleanliness, preservation, and appearance may be also said to be guided by the same rules in all ships. Systematic organization, co-operation, and routine are the means employed, and the machinery by which these are carried out is constantly oiled and adjusted so as to avoid friction.

Of these elements organization and routine take precedence as they start the machinery, but to co-operation is given the honour of achieving the result; and on the co-operation of all the atoms employed depends the efficiency of a man-of-war, no matter what her name or nation.

To assist us in the consideration of this element, we cannot do better than to refer to a note on the first chapter of the first book of Adam Smith's "Wealth of Nations," which appeared in 1840, by the well-known political economist Edward Gibbon Wakefield. He says: "All improvements in the productive powers of labour, including division of employments, depend upon co-operation. Co-operation appears to be of two distinct kinds: first, such co-operation as takes

place when several persons help each other in the same employment. Secondly, such co-operation as takes place when several persons help each other in different employments. * * * *

"In all operations it is absolutely necessary that many persons should work together at the same time, in the same place, and in the same way."

Now, men may co-operate together to hoist out a boat, gun, or other heavy weight, and the action of such co-operation is visible to all concerned, but in the interior economy of a man-of-war several men, or bodies of men, are employed at different times, in different pursuits, and in different parts of the ship.

A complex operation of the mind is necessary on the part of the Commanding Officer to ensure each of these parts working effectively so as to produce the best results. In a ship-of-war the formality of regular and systematical arrangement of the component pieces must be observed, and the whole must, so to speak, be held together in a cloak of essential unity, or, as Boyce expresses it,

> "Systems enclosed in his perception roll,
> Who's all enforming mind directs the whole."

It must again be observed that two separate forms of co-operation are necessary: one the co-operation of the various employments to form a whole; and the other the co-operation of individuals told off to the various employments; that is to say, the knack of accurately estimating the number of hands necessary for the performance of a job of work. Now, let anyone consider the question of legislating, day after day, for a ship's company of 700 men, so that none may be idle, none overworked, and all gradually assisting in perfecting the fighting powers, smartness, and cleanliness of the ship. Consider the immense variety of occupations, and the importance of a convenient distribution of them. Reflect on the task imposed on the director and organizer. Yet this object is accomplished through the agency of men who think each of nothing but his own immediate interest; who, with that object in view, perform their respective parts with cheerful zeal, and combine, unconsciously, to effect an object the vastness of which it would bewilder them even to contemplate.

Past.

It is not possible in the space available, even if it were necessary, to give anything like a detail of what has occurred in past ages. It will, I hope, be sufficient to glance at the main points of difference between the first half of this century and the present time. That will be taking the best of the sailing period, before the influence of steam had become palpable to the Navy. It is upon these data and on this comparison that I shall venture to predict the future.

During the whole of that period the system of manning was a serious drawback to the perfection of the interior economy of a man-of-war. Ships were frequently months unable to complete their complements, and, after they got their men, much time was spent in thrashing them into shape. Speaking generally, the gunnery system was of the loosest description, and each ship improvised the drills and exercises

that suited them best. There were no standard watch-bills, and the stationing of the ship's company was left very much to the Commander or First Lieutenant. That many ships are reported to have arrived at a high standard of efficiency is due more to the Officers who commanded them than to any general system of organization or training.

That health and cleanliness have long been considered to have an important place in the interior economy, even amongst the exhilarating and disturbing influences of a great war, we have ample evidence; but I need only quote from the Regulations of 1815 to 1826 in order to establish the fact, and it may also convey some idea of the management in those days.

Chapter IV, Article 1, says:[1]—

"As cleanliness, dryness, and good air are essentially necessary to health, the Captain is to exert his utmost endeavours to obtain them for the ship's company in as great a degree as possible. He is to give directions that the upper decks are washed very clean every morning, and that the lower decks are washed occasionally, when the weather will admit of their being properly dried; they are to be swept twice, at least, every day, and the dirt collected on them thrown overboard. The hammocks are to be carried upon deck, and the ports are to be opened whenever the weather will admit of it; and no more chests or bags than shall be necessary for the comfort of the men shall be kept on the lower gun-deck, that as few interruptions as possible may be opposed to the free circulation of air; and the hold and store-rooms are to be ventilated by wind-sails.

"The ship is always to be pumped dry, the pump-well frequently swabbed, and a fire, with proper precautions, let down to dry it. If the weather should prevent the lower deck ports from being opened for any considerable time, fires are to be made in the stoves supplied for that purpose, and the lower decks are to be kept as dry and clean as possible.

"The Captain is to be particularly attentive to the cleanliness of the men, who are to be directed to wash themselves frequently, and to change their linen twice every week. They are never to be suffered to sleep in wet clothes or wet beds, if it can possibly be prevented; they are frequently, but particularly after bad weather, to shake their clothes and bedding in the air, and to expose them to the sun and wind."

The rating of ships and the strength of their complement according to the number of guns they carried, also belongs to the past.

With guns from ten to twenty times the power, owing to improved machinery, we only require the same number of men per gun; and this makes a vast difference in carrying out the interior economy.

From Past to Present.

In proceeding from the consideration of the interior economy of the past to that of to-day, we must not fail to pay a just tribute to the foresight of those who placed an indelible barrier between these two

[1] "Naval Instructions," 1815 to 1826, Radstock Collection, R.U.S.I.

periods. I allude to the Committee of naval Officers who sat in 1852, to consider the expediency and practicability of engaging men and boys for longer terms of continuous service; and to the Board who ordered that Committee and framed the Order in Council of the 1st April, 1853. They addressed the Crown as follows:—

"We fully concur in the view expressed by the Committee, and we are of opinion that it is essential to give the Royal Navy a permanent constitution, in order that it may be brought to a higher point of organization, efficiency, and discipline, and thus be enabled at critical junctures to fulfil the expectations of your Majesty and the country. We humbly submit that all boys who hereafter enter the Navy be required to engage for a period of ten years' continuous and general service, from the age of 18, in addition to whatever periods may be necessary until they attain that age."

Nor must we forget the pioneers who led the way. The humble efforts of Thomas Urquhart, in his letters to Lord Melville and Mr. Wilberforce, in 1815, on the subject of impressment; and the larger and still more weighty work by Captain Anselm John Griffiths, R.N., on "Impressment Fully Considered, with a View to its Gradual Abolition and the Substitution of Voluntary Service," written in 1826. To these and many others, who have devoted their lives to the improvement of the interior economy of a man-of-war, and the comfort of the men, we owe the fact that we are now a purely voluntary service, the numbers only being limited by the demand.

Present.

The regulations for the administration of all connected with the interior economy of a man-of-war are laid down in the Queen's Regulations and Admiralty Instructions, which are officially published, and therefore I will not do more in this paper than make a reference to their existence. Combined with the daily and weekly routine, they are the motive power which drives the machinery of the interior economy. It will, I hope, be sufficient to give a short outline of the descending scale of responsibility through the various grades who form the executive, adding a description of the routine, as carried out in ironclad ships.

The arrangement of responsibility in the interior economy of the man-of-war of to-day may be briefly stated as follows:—

The Captain is responsible for all.

The Commander, or, where none is borne, the First Lieutenant, is responsible to the Captain for all.

With reference to the clothing and personal cleanliness of the men, and their conduct at gun and sail drill, the Lieutenants are responsible through the Commander, to the Captain, for the regulation of the details of their respective divisions, quarters, masts, or deck party.

The detail of cleaning ship throughout is regulated by the Commander, assisted by the First Lieutenant below the upper deck, and by the mates of decks, now nearly always warrant officers.

The guns are under the care of the Gunnery Lieutenant, who also carries out the detail of instruction in gunnery ordered by the Captain

and Commander, and the torpedo where there is no Torpedo Lieutenant.

The torpedo work (where a Torpedo Lieutenant is borne) is carried out by him in addition to his other work, with a special allowance for *the* extra. The duties connected with torpedoes have not *yet* been considered sufficient to excuse the Officer who performs them.

The First Lieutenant carries out the detail of instruction in seamanship to the midshipmen, ordinary seamen, and boys, subject to the approval of the Captain and Commander. The remaining Lieutenants take their turns as Officer of the watch, usually at an average of six hours a day, and while performing that duty are in charge of the ship, and responsible to the Captain for every detail connected with her.

The Sub-lieutenants assist the Lieutenants in their general duties—there usually being one in large ships to assist the Navigating Officer, one in charge of the steam pinnace. The senior performs the important duty of senior member of the gun-room mess.

The midshipmen, besides receiving instruction, keep regular watch under the Lieutenants as far as it does not interfere with their instruction, and, with the same restriction, carry out the boat duty.

It may be generally stated, that the heads of other departments are responsible to the Captain for the details connected with their respective departments. The Staff Commander or Navigating Lieutenant, for the correct navigation of the ship from port to port, also assists in preserving her station in the fleet when the hands are on deck and in action. He is also responsible for the correct keeping of the ship's log, and the demands for, and expenditure of, the warrant officers' stores.

The Fleet or Staff Surgeon, for the health of the ship's company and details connected with the sick bay or ship's hospital, regulation of the sick list, sending men to shore hospitals, &c.[1]

The Paymaster, for all connected with the payment, clothing, and provisions of the ship's company, the ship's books, certificates, record of conduct, savings, allotments, remittances, &c., &c.

The Chief Engineer, for the machinery, boilers, coal, &c.

The warrant officers may now be said to come under two heads: first, the gunner, boatswain, and carpenter of the ship, who have respectively charge of the stores coming under their warrant; secondly, the supernumerary warrant officers, who perform the duty of mates of decks, &c.

Below this again come the chief petty officers, each having his function in his own part of the ship.

The master-at-arms, who is the head of the ship's police, an entirely independent body, necessitated by the existence of crime and its punishment.

The chief gunner's mate, who is also usually a gunnery instructor, and who assists the Gunnery Lieutenant in the details of instruction.

The chief boatswain's mate, who assists the boatswain, and who is generally in charge of all that relates to the upper deck and outside of

[1] This and the following paragraph, relating to the Paymaster, were added subsequent to the meeting.—ED.

the ship. The chief captain of the forecastle, who also, under the boatswain, has charge of all that relates to the head booms and anchor gear. The chief signalman, who in flag-ships has charge (under the Flag Lieutenant and signal mate) of the signal department. The chief quartermaster, who has charge of the hand wheel, tiller ropes, compasses, &c., under the Navigating Officer. The chief carpenter's mate, under the carpenter, has charge of the carpenter's crew.

The seaman schoolmaster, who is in charge, under the Chaplain, of the education of the boys and voluntary study of the men.

The ship's steward, who is in charge, under the Paymaster, of the victualling and storage, and issue of clothing. The ship's cook, who is in charge of the galley and general cooking for the ship's company. These last three do not take military command.

The chief petty officers mess by themselves, and have a boy in each watch told off to assist in cleaning, &c. They are an important item in the distribution of ulterior responsibility in a man-of-war.

The next, and perhaps the most important step, as far as the good order of the interior economy is concerned, is the grade of first-class working petty officer, such as captains of the tops, forecastle, quarter-deck, gunner's mates. They superintend and are responsible for the individual work done by, and the conduct of their men. The captains of the tops also look after all gear above the top on their respective masts, the gunner's mates taking the main, and the captains of the forecastle the foreyards and lower rigging. Besides this, they are, as a rule, captains of guns, and not unlikely markers of the small-arm companies. The ship's corporals assist the master-at-arms as "ship's police."

The quartermasters keep regular watch under the Lieutenants and midshipmen. They look after the steering at sea, and are placed in the chains as leadsmen in narrow channels, proceeding in and out of harbour, &c., and report the times on the routine board. They assist the chief quartermaster and also the Navigating Officer.

The boatswain's mates also keep regular watch; they convey by pipe and voice all orders that necessitate turning up the hands, watch, or part of a watch, and assist in seeing ropes manned, yards trimmed, &c.

The remaining first-class petty officers hold individual ratings such as Captain's coxswain, coxswain of the launch, who look after their boats and crews; and the captain of the hold, sailmaker, ropemaker, carpenter's mates, caulker, armourer, blacksmith, who are rated first-class petty officers rather to give them position and pay than military command.

The first-class petty officers are usually divided into two messes, one on each side of the deck.

The second-class petty officers assist the first in connection with their duties aloft and on deck; and have besides the very important duty of petty officers of the messes.

The leading seamen are a class of aspirants for petty officers' rate, from among the best of the able seamen, who are required to pass a severe examination in seamanship, and show by their conduct, zeal, and ability that they merit being admitted to this, the first grade of

responsibility. They are frequently in charge of small parties of men such as "a hand from each part of the ship," &c., and are placed in the chains next to the quartermasters.

Three of them in large ships are captains of the crosstrees, and in that capacity a good deal of the responsibility for the upper yard and mast work comes upon their shoulders.

The able seamen form the nucleus of the strength of the ship's company. They have concluded their arbitrary instruction in seamanship, except that conducted with all hands, or the watch, but they are still systematically instructed in gunnery and small-arm drill, and mostly gain the rating of trained men.

The ordinary seamen and boys, though useful as higher numbers in the guns' crews, powder men, royal yard men, boats' crews, and in cleaning ship, can scarcely be said to add materially to the efficiency of the ship.

The stokers on board a man-of-war may be said to have a distinct, if not a separate organization. They work in the stoke-hole and engine-room, and tend fire mains at fire quarters and in action; working on deck with the hands at general exercise aloft, in and out boats, &c.

The above, I hope, fairly describes the distribution of work and responsibility of the blue-jacket element of a ship.

The useful and important work done by the corps of Royal Marine Artillery and Light Infantry cannot be omitted in dealing with the interior economy of a man-of-war.

They furnish the guard by whom the duty of sentry in all parts of the ship is performed under the non-commissioned officers and Officers on duty.

The working party under a sergeant are usefully employed with the remainder of the hands or watch.

They are stationed at guns, and as small-arm men on the upper deck in action, and assist on deck at general exercise, in and out boats, &c.

They have separate messes, which are usually termed the "barracks." Each mess is in charge of a corporal, the sergeant-major and sergeants having a small mess to themselves.

The daily and hourly interior economy of a man-of-war is regulated by routine which, under ordinary circumstances, does not alter during the commission.

The routine board, probably resembling that which has been prepared for the illustration of this paper, is usually framed and hung up in a conspicuous place on the main deck; and the duties, drills, &c., apportioned to the several times are, when the outside exigencies of the Service permit, rigidly carried out.

The routines are organized under the heads of summer and winter, sea and harbour.

It will be observed that in the sea routine the cleaning commences earlier, namely, at 4 o'clock; but the men employed belong only to one watch, as the men who had the middle watch are not turned out till after the decks are done. The decks having been cleaned, and the sails re-set, the awnings are spread, and at 6.15 the hammocks are

stowed, after which the bugle sounds for the cooks of the messes to repair to the coppers, and the hammocks of the guard and subordinate officers are stowed. At 6.45 all hands go to breakfast.

At 7.15, that is, when the ship's company have had half an hour to breakfast, the watch coming on deck (forenoon watch) clean in a blue working dress, and the duty men, namely, quartermasters, signalmen, duty boats' crews, clean, in the rig of the day. The watch below clean the lower deck, and also what are now known as the flats or compartments formed by watertight bulkheads.

At 7.30 the forenoon watch are fallen in, put through the station for one evolution, and then clean the bright work.

At 8 o'clock all hands go to quarters, clean guns. The pump gear is cleaned on Mondays and Wednesdays, and then the hands are piped to clean. The roll is beat, and all hands clear off the lower parts of the ship, when the Commander and First Lieutenant go the rounds. "Ready for morning quarters" is reported to the Captain, and the bugle is sounded to divisions. The men are all inspected, and reported correct by the Lieutenants, after which prayers are read on the quarter-deck or main-deck in rainy weather.

The various routines differ mostly during the period from commencing to scrub decks till time for quarters.

In harbour during the summer the hands are fallen in, and the upper and half deck cleaned at 4.50, and the duty boats' crews clean their boats out. The hammocks are stowed at 6, and the men breakfast at 6.30. At 7 the forenoon watch, clean, in a blue working rig, duty men and boats' crews in the rig of the day, and the watch below clean mess deck and flats.

At 7.15 the forenoon watch and duty boats' crews fall in, clean bright work, and if top-gallant masts are down, overhaul top-gallant rigging. At 7.50 the upper yard men fall in, and then the daily morning evolution is performed.

This exercise consists, as will be seen by reference to the weekly routine, of replacing whatever has been sent down the night before. On Monday and Tuesday royal yards, on Wednesday and Thursday cross upper yards from top-gallant masts down. On Friday cross royal yards, then prepare for action aloft by sending down top-gallant masts and all booms, bracing up yards, running in head booms and toggling braces. In the performance of these evolutions, the watch on deck always perform the duty aloft.

The morning evolution complete and the yards square, the guns come in for their share of polish as at sea, and then the hands clean, after which the rifles, pistols, cutlasses, are cleaned, and on Tuesdays and Thursdays the bugle is sounded to put belts on, and the small-arm men are inspected by the Lieutenant-Captains of the companies; one of these days being devoted to exercising landing parties consisting of small-arm men, field guns, pioneers, bearers, band, &c. After prayers the routines are much alike till noon, except that in harbour on Monday there is general exercise aloft; on Wednesday an anchor and cable is laid out, or the boats are manned and armed, at the expiration of the dinner-hour; and on days when the weather permits of the sails

being loosed, they are furled at 11; and that at sea only one watch is on deck, and in harbour both watches. At 9.45 there is a watch-drill consisting of shifting a spar or sail, and at 10, the regular drills of the ship, consisting of the instruction of untrained men, and a portion of the quarters exercised under the Gunnery Lieutenant and instructors. The ordinary seamen and boys are instructed in seamanship under the First Lieutenant and instructors. This party is frequently exercised aloft, loosing, reefing, and furling, sending down royal yards, &c. The remaining hands or watch are told off to the various jobs necessitated by wear and tear. At 11 the cooks of the messes of the watch below get the spirits up, and at 11.30 the decks are cleared up, all work put away, and the wood and bright work touched up.

At a quarter to 12 the cooks repair to the coppers, and at 12 o'clock all hands are piped to dinner. The grog is served out to those who are allowed it at 12.30, and smoking is permitted during the dinner-hour.

At 1.25 the lower deck is cleared up, and at 1.30 the watch or both watches are fallen in, and the instructions, exercises, and jobs of work detailed as in the forenoon. At 3 the watch fall in, and again shift a sail or spar. At 3.50 the upper yard men going aloft fall in, and at 4 o'clock the evening evolution is performed, which consists of sending down that which is to be replaced the following morning, and here it will be observed there is a considerable difference between the sea and harbour routine, for at sea the decks are cleared up, and the watch below shift into night clothing at 3.45, the remainder shift into night clothing at 4, and go to supper at a quarter-past; evening quarters coming after supper, and then *every* evening general exercise aloft, shifting spars, sails, &c. In harbour, after inspection at quarters, the cooks repair to the coppers for the tea, and the men shift into night clothing; then supper, and then furl awnings, up ropes and boats, bathe, &c.

At 7.15 in all cases the guard and subordinate officers' hammocks are piped down, and the remainder at 7.30.

Each day concludes with clearing up the decks: in harbour at 8.30 P.M., at sea 8 P.M., after which the Commander goes his rounds to all parts of the ship accompanied by the Marine Officer on duty, the mates of decks, the master-at-arms and corporals, the yeomen of stores attending in their store-rooms, and the engineer on duty in the engine-room. In harbour the ship's company are piped down at 9.30 P.M., but at sea the first watch remain up until relieved at 12 by the middle, which is again relieved at 4 by the men who kept the first, and so on.

The forenoon of Friday is devoted in all cases, sea and harbour, winter and summer, to the very important task of exercising, and, as far as possible, perfecting the preparation of the ship for battle in all its details. On alternate Fridays the preparation aloft takes place as already described, after which the bugle sounds for action without powder, and the whole ship's company to a man are inspected by and drilled under the Captain, then by the Lieutenants in charge of the quarters, and then at boarding, with pikes, cutlasses, &c. In the mean time the fire brigade are exercised, collision mats are got over and placed, damaged rigging secured, &c., &c.; then clean guns.

On Friday afternoon all dirty canvas gear, such as wind-sails, deck clothes, &c., is scrubbed, and the booms are cleaned.

The afternoon of Thursday is, when the service permits, given to the men to make and mend their clothes; and the clothes are washed on Mondays and Thursdays, the hammocks being scrubbed on every alternate Monday.

Saturday is universally devoted to cleaning ships, guns, arms, &c., and polishing up wood and bright work.

The punishments form an important feature. All minor offences have their allotted number of days' black list, which is adjudicated by the Commander, or where none is borne, by the First Lieutenant every morning at 11.30. All serious offences are referred to the Captain, who selects from them those sufficiently so for court-martial. A defaulters' book is kept, in which all offences are registered, and all reports are made through the master-at-arms as head of the police.

The above details may all be considered as coming under the head of routine, but it must not be forgotten that there are elements in the life of a ship which sometimes upset the wisest calculations.

Arrival or departure from port, coaling, provisioning, taking in and discharging powder and shell, docking and undocking, general leave, &c., all more or less interfere with the exact carrying out of the routine laid down, and it can only be looked upon as a general scheme to carry out the interior economy of a ship, subject to the incidents caused by her movements from port to port.

Weighing when moored will usually take, and throw out the routine for, the best part of a forenoon. Coaling with your own ship's company is an evolution of itself, and with 500 or 600 tons to come in, you cannot estimate at a higher rate than from 90 to 100 tons an hour, and after this there is a special cleaning for ship and men. While general leave is going on it is clear that the whole work has to be done with half the men.

Again, at sea the quarter's allowance of powder and projectiles for target practice have to be expended, a portion being fired in each month; this practice culminating in a rivalry between the guns' crews for the first place in prize firing, which takes place annually.

The interior economy of a man-of-war is rigidly inspected by the Admiral in command of the station or fleet at least once a year, and a report of the ship sent in to the Admiralty.

These inspections are not made at any stated times or seasons; in fact, it is not usual to give more than the necessary notice to have the men cleaned in tunics and the books ready, mess-statements, &c.

It would be out of place for me to make any comment on the state of efficiency of the men-of-war of to-day, but I may be allowed to quote the expressed opinion of a writer in the "Nautical Magazine" for July, 1879, with whom I venture to agree: "In most particulars we have enormously raised the standard of efficiency in the Navy. We have introduced system where none existed before, and organization where chaos reigned hitherto. Taken as units of our force it would be, perhaps, difficult to surpass the efficient state of our individual ships even in the future; in the past it has certainly never been

equalled." One thing is clear, that the one great blot of waiting for your ship's company to join is a thing of the past.

It is no exaggeration to say that in the present organization for manning the Navy you can embark a ship's company in the forenoon, give them bags, hammocks, messes, and numbers on the watch-bill, and go to dinner at 12 o'clock, exercise at fire quarters in the afternoon, and give special and privileged leave at 4 P.M., and the ship starts at nearly the same stage as would have been arrived at half a century ago after a year's commission.

I have given the detail for a fleet ship, but the same rules govern, and the same drills and exercises are carried on in all men-of-war, toned down and varied to suit the rigour of the climate or the service on which a particular ship may be from time to time employed.

Leave is an important feature which is worthy of notice. Leave is an indulgence at first open to all. There are three classes, special, privileged, and general, 1st, 2nd, and 3rd. The first go whenever the Officers go, the 2nd when it is convenient to send them, and the 3rd once a month when the service or nature of the port visited permits.

Those who know how to look after themselves remain special leave men all the commission. Those who are not so careful proceed through the privileged to the general, where they remain until six months clear.

There is a class for habitual leave breakers, where the few incorrigible finally gravitate, the only rule for them being that they are allowed out of the ship once in three months. Besides leave, volunteers are always encouraged to go away pulling in the boats of the ship round a marked course, and in fleets, periodical regattas and field sports are organized.

Monthly advances are made to the men of nearly the whole of their pay, which they can allot or remit at will.

What a contrast to the past! Let us, for one moment, go back fifty years—listen to a description of the then state of things: "Kept for years on foreign stations, debarred the shore, and frequently and for long periods without a penny in their pockets, landing in England with fifty, sixty, or seventy pounds, with twenty-four hours to spend it in!!! Surrounded by the profligacy of our seaport towns, and enticed to the commission of every excess, assailed by every temptation, inflamed with liquor, and looking forward to another long absence and a similar confinement. What can be expected but a reckless indifference to conduct?"

Let us be thankful that the glaring errors of the past have been rectified, and let us redouble our efforts so that the future may prove an equal improvement on the present.

FUTURE.

Having endeavoured to make some comparison between the past and the present, we come to the question of the future, and it may briefly be stated as follows: is it likely that we shall ever be able to do away with all sail power, root and branch, or is it more probable

that sailing cruizers and masted vessels will take us through the next century? and their corollaries—shall we have to do away with the gymnasium, *i.e.*, sail drill, mental and muscular exercise combined for the Officers and men—which, in my humble estimation, is the making of our ships' companies, and imparts to them a healthy tone, morally and physically, or shall we seek for a substitute? It will need but little word-painting to picture what a dog's life it would be on board a ship with no exercise: a substitute therefor we must have if large bodies of men are to be confined on board ship. It may be that it will be necessary to seek for it under the form of systematic wholesome recreation, but have it in some form or another we must.

We have not far to seek in the reports of many scientific medical men for opinions on the value of mental action during muscular exercise. It is a recognized fact that without a mental stimulus muscular exercise is of little use to the healthy development of the body, and not only so but the capacity for sustaining fatigue during such exercise is far greater where the mind is employed equally with the body. These conditions are best complied with in the case of fleet exercise, where ships join in friendly rivalry for the first place, or in mast against mast in a single ship.

It has been remarked by Andrew Coombe, M.D., the talented author of the principles of physiology applied to the preservation of health, and to the improvement of physical and mental education, "that exercise should always spring from, and be continued under, the influence of an active and harmonious, nervous, and mental stimulus," again the very conditions which govern drill aloft.

This recognized authority carries out his reasoning on lines which would almost appear to have been written for the special benefit of this question. He tells us that the simple fact that the muscles are expressly constructed for the purpose of fulfilling the commands of the will, might of itself lead to the inference that a healthy mental stimulus ought to be considered an essential condition or accompaniment of exercise; and accordingly the muscular action becomes easy and pleasant under the influence of mental excitement, and a vigorous nervous impulse is useful in sustaining and directing it. On the other hand, how difficult, wearisome, and inefficient muscular contraction becomes when the mind, which directs it, is languid or absorbed by other employments. We see this principle established in every-day sports—a sportsman after game who is getting a fair bag will shoot on till he drops—through turnips and over ploughed fields, where the same man could not do half the distance along a high road with no object.

The same phenomenon is illustrated in cricket, football, dancing, and particularly in fleet exercises. Facts illustrative of the beneficial influence of a mental stimulus as the only legitimate source of muscular activity, abound everywhere, and must be familiar to every reflecting mind.

Those who can call to mind the line of battle squadron in the Mediterranean twenty years ago, when the efficiency and rivalry reached a point which it is doubtful will ever be surpassed—when a

ropes-end down the main hatchway brought all hands on deck—and the signalman of the watch cleared lower deck because he fancied the Flag Lieutenant was a little fidgety on the poop of the flag-ship—will remember the elastic spring, the bright eye, the cheerful glow of beings thus excited, and will be able to contrast them in their mind with the spiritless and inanimate aspect of the ship's company of a mastless ironclad with but little drill and no competitive exercise.

The same important principle was implied in the advice which the "Spectator" tells us was given by a physician to one of the Eastern kings, when he brought him a racket, and told him that the remedy was concealed in the handle, and could act upon him only by passing into the palms of the hands when engaged in playing with it; and that, as soon as perspiration was induced, he might desist for a time, as that would be a proof of the medicine being received into the general system. The effect we are told was marvellous! The story of an Englishman who conceived himself so ill as to be unable to stir, but who was prevailed upon by his medical advisers to go down from London to consult an eminent physician in Inverness who did not exist, may serve as another illustration. The stimulus of expecting the means of cure from the northern luminary was sufficient to enable the patient not only to bear, but to reap benefit from, the exertion of making the journey down, and his wrath at being tricked sustained him in returning, so that on his arrival home he was nearly cured. Nature will not be cheated! and the healthful results of complete cheerful exertion will never be obtained where the nervous impulse, which animates the muscles, is denied.

The force exerted by strong muscles, animated by strong nervous impulse or will, is prodigiously greater than when the impulse is weak or discordant, and man has ever excelled most where he has followed this law of nature.

It thus becomes a matter for serious consideration and discussion, as to what form the exercise of the future is to take. The elements required are plain enough—"practical utility combined with innocent entertainment." How are we to apply them?

Again, although the doctrine of finality has not yet been arrived at, the lasting power of ships is attracting attention. The "Himalaya," for instance, is not a bad specimen of mileage done by one ship. And the, I may say, wonderful result of the suggestion of the Boiler Committee, "to prevent or neutralize the corrosion attributed to the presence of air, by the application of zinc when the boiler is full, and coke and lime when empty, leads us confidently to assume that the durability of the boilers will be considerably augmented, and may possibly rival the lasting powers of the ships."

Now, take in conjunction with these very satisfactory increases in the longevity of ships and boilers, the gradual yet certain increase of docking power all over the world; and we may venture to predict, with some degree of accuracy, the recommissioning of the future. Already recommissioning ships abroad is an ordinary circumstance. How much more so, when you get ships that will last half a century and can be docked on their stations.

So that it is probable that circulation ships for carrying out relief crews, and bringing home relieved crews, time-expired men, invalids, &c., will become a standard element in naval equipment.

In a recent essay written in competition for the Gold Medal of this Institution, I drew out a scheme for carrying out this duty. The important point which connects that scheme with this paper is the preliminary training which all crews would get on the outward voyage in practical seamanship and supplementary training on the homeward voyage. I would thus suggest a point for discussion as follows:—"The tendency being to build for war purposes mastless turret-vessels, and it being possible and most desirable that they may remain on their stations for a number of years, that it is desirable to establish a system of training circulation ships in order to train in practical seamanship while carrying relief crews."

It may be urged that the stations near home, such as the Mediterranean and West Indies, would not benefit equally with Australia, China, and the Pacific. But that could easily be arranged by starting the circulator three or even six months before the date of relief, sending her in the case of the Mediterranean to the Azores, Madeira, Gibraltar, calling at all ports to Barcelona, crossing to Algiers, and eventually reaching Malta.

In the case of the West Indies, what better training ground could we have than would be found in a sailing cruize *viâ* Madiera to Barbadoes or Trinidad, and then calling at all islands to Bermuda, Halifax, or wherever she was wanted, delivering her men with at least some practical experience of the art of handling a vessel under sail?

From want of space, I have been unable to open up the questions of the numerical strength and duties of our ships' companies of the future; and I may state that I do not see any reason why we should predict any radical change, except in matters of detail, in the immediate future. But I think it would be an interesting feature in the discussion. With regard to the numerical strength of the crews of the future, we had two very decided opposite opinions on Wednesday last at the discussion on the *personnel*. Captain Noel, R.N., said, "that we had not enough men in our ships of war," and Sir Michael Seymour mentioned "that we had as many as they could stow." . . .

It is a question of some importance as to whether machinery in ships is to take the place of manual labour. There is no doubt that a great deal that is now done by the men might equally well be done by steam power, compressed air, &c., and at a cheaper rate. But there are the disadvantages of loss of training and the placing of a still greater barrier between the mastless ironclad and the cruizer class, besides the loss of the power of "landing brigades," forming boat attacks, &c. There is no doubt that the use of machinery is increasing, though I am happy to say not from the same cause as with the Romans—namely, the want of men. Vegetus tells us, "the use of machines in the field" gradually became more prevalent in proportion as personal valour and military skill declined with the Roman Empire; when men were no longer found, their place was supplied by

machines. Let us hope that the application of those words to this country may be long deferred. Nevertheless, let us bear them in mind as a warning.

The development of sub-aqueous or ærial machines, in their relations to the fighting powers of ships, is a study of itself; but I do not apprehend that it will make any radical change in the interior economy.

Notwithstanding one or two expressions which have fallen, both here and in another place, relative to the extreme polishing up which goes on in the Navy, I venture to hope that the men-of-war of the future may be as famed for "That brightness which obtrudes itself upon the eye," as those of the present and past, always bearing in mind that it is the unity of the whole which is so commendable, and that it is no use to brighten up a part unless you work up all the other parts to match. The increase of intelligence and order, and the decrease of crime and its punishment, are surely making themselves felt, and the result is, as it ever must be, increased happiness and comfort.

I have not gone into any detail of the actual fighting of a man-of-war, as that would form a subject for a paper of itself. The following lines will perhaps give some idea of the constant battle which is going on in all ships:—

The absence of an actual fight may seem a sad omission,
But there is a battle going on in every ship's commission.
When first the pendant flies, the battle is begun,
To be renewed, from day to day, beneath each morning sun.
Steadily and hopefully, a hard fight all the time,
Our enemy is laziness, our greatest fear is crime.
Our object that when other ships should dare with us compete,
To make the ship in which we serve the first of all the fleet!
As kings in bygone days led on their royal guards,
So we begin our battle by crossing royal yards,
And if we don't at first succeed, must try, and try again,
Until the yards shall seem to fly, on mizen, fore, and main.
And as they trod their fallen foes, without a single check,
So we must send down upper yards, and land the masts on deck,
In general exercise aloft, beat everything that floats,
Be No. 1 in shifting jib and hoisting out the boats.
In laying out stream anchor, with all its weight of cable,
Our watchword is to other ships, beat us if you are able;
But we must look to everything, commencing with the spanker,
And crossing over all mastheads, be getting up the anchor;
Though here we have a friend, whose Christian name is steam—
A trusty horse who works away, and never tired does seem,
And as the capstan turns, he gives a sort of cackle,
Just as if he wished to say, "There goes another shackle."
Enough of this, there's something more, by which our hopes are buoyed,
We serve a glorious country, by whom we are employed.
Remember that Britannia's flag is floating from our peak,
Remember that in danger, they're sure our aid to seek!
Remember Nelson's victories, remember Nelson's fame,
And let us strive to do our best, that we may win the same.
And of one thing be sure, wherever you may be,
The cleanest and the smartest ships are happiest on the sea.

APPENDIX.

HARBOUR ROUTINE.

A.M. SUMMER.

4.40—Call boatswain's mates, corporals, and mates of decks.
4.45—Hands.
4.50—Hands fall in, scrub upper deck. Duty boats' crews clean out.
5.45—Hammock stowers, royal yardmen, and boys lash up and stow, royal yardmen clean conductors, spread awnings.
6.0—Lash up and stow.
6.10—Steerage hammock men, watch below fall in, sound reveille.
6.15—Cooks, up guard and steerage hammocks, bathe.
6.30—Breakfast.
7.0—Forenoon watch to clean in blue working dress, duty men and boats' crews in rig of the day. Watch below clean main deck and flats.
7.15—Watch and duty boats' crews fall in, clean bright work, if top-gallant masts are down overhaul top-gallant rigging.
7.50—Upper yardmen fall in, up all wet deck clothes.
8.0—Evolution, then quarters clean guns.
8.35—Mondays and Wednesdays clean pump gear.
8.50—Return rags.
8.55—Disperse, hands to clean.
9.10—Roll, sweepers.
9.20—Quarters, prayers.
9.45—Watch drill.
10.0—Drills as ordered.
11.0—Cooks, watch below, up spirits.
11.30—Clear up decks.
12.0—Dinner.

P.M.

1.25—Roll, sweepers.
1.30—Watch fall in.
3.0—Watch drill.
3.50—Upper yardmen fall in.
4.0—Evolution, quarters.
4.15—Cooks, shift into night clothing.
4.30—Supper.
5.0—Both watches fall in, furl awnings, coil up ropes.
5.30—Bathe, up boats not required.
7.10—Steerage hammock men fall in.
7.15—Stand by guard and steerage hammocks.
7.30—Stand by hammocks.
8.30—Clear up main deck.
9.0—Out pipes, rounds.
9.30—Pipe down

A.M. WINTER.

5.10—Call boatswain's mates, corporals, and mates of decks.
5.15—Lash up and stow.
5.30—Cooks.
5.45—Breakfast.
6.15—Hands to clean in blue working rig.
6.25—Both watches fall in, clean upper deck, upper yardmen clean lightning conductors, duty boats' crew clean out, up guard and steerage hammocks.
7.0—Watch below clean main deck and flats, watch dry upper deck, coil down ropes.
7.15—Overhaul top-gallant rigging if top-gallant masts are down.
7.50—Upper yardmen fall in.
8.0—Evolution, then quarters, clean guns.
8.35—Clean arms Tuesdays and Thursdays, clean pump gear Mondays and Wednesdays.
8.50—Return arms or rags.
8.55—Hands to clean.
9.10—Roll, sweepers.
9.15—Quarters.
9.45—Watch drill.
10.0—Watch fall in, drills as ordered.
11.0—Cooks, watch below, up spirits.
11.30—Clear up decks.
12.0—Dinner.

P.M.

1.15—Roll, sweepers.
1.20—Watch fall in.
3.0—Watch drill.
3.50—Upper yardmen fall in.
4.0—Evolution, quarters, coil up ropes.
4.30—Cooks.
4.45—Supper.

TUESDAY AND THURSDAY.

Routine for Small Arms.

A.M.

8.40—Return rags.
8.45—Hands to clean.
9.0—Clean arms.
9.10—Roll, sweepers.
9.15—G. put belts or return arms.
9.20—Quarters.

FRIDAY.

A quarter of an hour is to be given for cleaning guns, then pump gear. Clean guns after quarters.

SUNDAYS.

Summer and Winter.

A.M.
5.30—Lash up and stow.
5.45—Cooks.
6.0—Breakfast.
6.25—Steerage hammock men fall in. Reveille.
6.30—Up guard and steerage hammocks, hands to clean in blue working rig, duty men in rig of the day.
6.45—Watch below clean main deck, watch fall in, clean upper deck as ordered, then wood and bright work, duty boats' crews lower and clean out.
7.30—Duty boats' crews to clean.

A.M.
7.50—Quarters, clean guns.
8.30—Disperse, hands to clean.
8.50—Roll, watch fall in, clear up decks for divisions.
9.30—Divisions, divine service.
P.M.
3.50—Roll, sweepers.
4.0—Quarters.
4.15—Cook's hands shift into night clothing.
4.30—Supper.
5.0—Coil up ropes.
If awnings are to be spread lash up at 5.15, spread awning at 5.30, furl at 5 P.M.

SEA ROUTINE.

Summer.

A.M.

3.30—Coil up ropes.
4.0—Scrub decks.
5.45—Re-set sails, &c.
6.0—Spread awnings, hammock stowers, royal yardmen, and boys lash up.
6.15—Lash up and stow, royal yardmen clean lightning conductors.
6.25—Steerage hammock men fall in.
6.30—Reveille, cooks, up guard and steerage hammocks.
6.45—Breakfast.
7.15—Watch below clean lower deck, watch clean in blue working dress, duty men in rig of the day.
7.30—Watch fall in, stations, clean bright work.
8.0—Quarters, clean guns.
8.30—Clean pump gear on Mondays and Wednesdays.
8.40—Return rags.
8.45—Disperse, hands to clean.
8.55—Roll, sweepers.
9.0—Quarters, prayers.
9.30—Watch drill.
9.45—Drills as ordered.
11.30—Clear up decks.
12.0—Dinner.

P.M.

1.25—Roll, sweepers.
1.30—Watch fall in, drills as ordered.
3.0—Watch drill.
3.45—Clear up decks, watch below shift into night clothing.
4.0—Cooks, shift into night clothing.
4.15—Supper.
4.45—Roll, both watches furl awnings.
5.0—Quarters, evolution.
7.10—Steerage hammock men fall in.
7.15—Down guard and steerage hammocks.
7.30—Stand by hammocks.
8.30—Rounds.

Winter.

A.M.

3.30—Coil up ropes.
4.0—Scrub decks.
6.0—Hammock stowers, royal yardmen, and boys lash up.
6.15—Lash up and stow.
6.25—Steerage hammock men fall in.
6.30—Reveille, cooks, up guard and steerage hammocks.
6.45—Breakfast.
7.15—Watch below clean lower deck, watch clean in blue working dress, duty men in rig of the day.
7.30—Watch fall in, re-set sails, clean wood and bright work.
8.0—Quarters, clean guns.
8.25—Clean arms.
8.35—Return rags.
8.40—Dispense, hands to clean.
8.50—Roll, sweepers.
9.0—Quarters, prayers.
9.30—Watch drill.
9.45—Drills as ordered.
11.30—Clear up decks.
12.0—Dinner.

P.M.

1.15—Roll, sweepers.
1.20—Watch fall in, drills as ordered.
3.0—Watch drill.
3.30—Shift into night clothing.
3.50—Roll, sweepers.
4.0—Quarters, evolution, cooks, supper.
7.10—Steerage hammock men fall in.
7.15—Down guard and steerage hammocks.
7.30—Stand by hammocks.
8.30—Rounds.

Tuesday and Thursday.

Routine for Small Arms.

A.M.

8.25—Return rags.
8.30—Hands to clean.
8.45—Clean arms.
8.50—G. put belts or return arms.
8.55—Roll, sweepers.
9.0—Quarters.

Friday.

A quarter of an hour only to clean guns, then pump gear. Clean guns after.

WEEKLY ROUTINE.

MONDAY.

Air bedding.
8.0—Cross upper yards.
9.0—Lash up or inspect bedding.
9.45—General exercise aloft.
3.0—Watch drill.
4.0—Down royal yards, evening quarters, wash clothes, alternate weeks scrub hammocks.

TUESDAY.

5.30—Lash up and stow.
5.45—Up, scrub hammocks.
6.0—Spread awnings.
8.0—Cross royal yards.
9.45—Watch drill.
4.0—Down top-gallant masts, evening quarters.

WEDNESDAY.

7.15—Overhaul top-gallant rigging.
8.0—Cross royal yards, loose sails.
9.45—Watch drill.
11.15—Furl sails.
3.0—Watch drill.
4.0—Down top-gallant masts, evening quarters.

THURSDAY.

7.15—Overhaul top-gallant rigging.
8.0—Cross royal yards.
9.30—Landing party.
10.15—Marines.
11.15—Furl sails.
4.0—Down royal yards, evening quarters, wash clothes.

FRIDAY.

7.15—Cross royal yards.
8.0—Prepare for action.
9.45—General quarters.
11.15—Cross royal yards, down upper yards.
P.M.—Scrub canvas gear, up yards, &c.

SATURDAY.

3.0—Up, clean hammocks, alternate weeks.
4.0—Mend furl of sails, evening quarters.

NOTE:—On Tuesdays in Winter.

6.25—Up, scrub hammocks.

Vice-Admiral LUARD, C.B.: I feel that I ought to apologize for beginning this discussion; but if I might venture to make a suggestion to the very able and painstaking author of this paper, it is that he should insert a single word in the paragraph in which he says, "The interior economy of a man-of-war must always be first considered with reference to rendering the ship a perfect fighting machine; next, as to the safety; and, lastly, as to the cleanliness, preservation, and outward appearance of the ship." I would suggest that before "cleanliness" the word "health" should be added, for Lieutenant Campbell has omitted in those remarks upon the interior economy of a man-of-war all reference to the medical staff, whose duties are certainly not unimportant.[1] Those few lines from the old Regulations of 1815, viz., "As cleanliness, dryness, and good air are essentially necessary to health, the Captain is to exert his utmost endeavour to obtain them for the ship's company in as great a degree as possible," are as applicable now as when they were issued, and the medical staff on board a man-of-war can always exercise a beneficial influence upon the health of the ship's company. Two rather remarkable instances occur to my mind. One was the case of a frigate in the River Plate, where there was a great deal of rough boat work. The boats' crews were constantly coming on board wet; and if the Commanding Officer did not give at once directions for the boat's crew to be shifted into dry clothing, the Surgeon made it his business in as respectful a way as possible to remind him that it was necessary that this should be done. The result was that we had less rheumatism, and the cases were far milder than those occurring in other ships employed on the same duty at the same time. Another case was that of a frigate carrying the Admiral's flag at Rio, where there happened to be a very serious outbreak of yellow fever. There were several hundred ships in the harbour—men-of-war and merchant ships; and, I believe, not a single ship except our own escaped. Some of the crews of these ships were indeed almost decimated, and our escape was attributed, humanly speaking, to the fact that very great pains were taken to keep the decks of the ship as dry as possible: in fact, the lower deck of the ship was not wetted for months together, and at the end of that time it was perfectly clean—cleaner, I believe, than if it had been wetted the whole time. These are two instances occurring to me at this moment, in which the medical Officers of the ship intervened in a way which perhaps they might not be compelled to do, but which their anxiety for the good of the public service induced them to do, and with very great success.

Sir F. NICOLSON: How was the deck cleaned?

Admiral LUARD: With dry holystone. The fighting capacity of a ship's company, of course, must depend upon their state of health and general physique; and these are points which the medical staff of the ship should have specially under their supervision. I therefore think that in a comprehensive review, such as this, of the interior economy of a man-of-war, we must not altogether lose sight of the part which is played in it by the medical staff. The suggestions of Lieutenant Campbell to provide a substitute for the healthy stimulus of exercise aloft, in mastless ironclads, are very valuable, and deserve to be further developed. No doubt some such substitute must be found; and let me say, in the words of the essay which carried off the Gold Medal, we must endeavour as far as possible to reconcile the traditions of the past with the requirements of to-day.

Colonel MALCOLM GREEN, C.B.: I should like to ask the lecturer to give us some explanation as to the duties and responsibilities of the Navigating Officer: I do not exactly understand what his responsibilities are.

Captain J. C. R. COLOMB: I should be very sorry if this paper were dismissed with the slight discussion we have had upon it; because it is a very interesting paper, and it conveys a great deal of information. It also deals with questions that are now coming every day before the Navy, especially with regard to the future. I feel a great hesitation in troubling you again, considering that I have spoken so recently; but my object in making a few observations is to start a further discussion. All who do not know what a ship of war is, and indeed who do know,

[1] Paragraphs on the Medical and Paymasters' Staff have been subsequently added to the paper.

must feel greatly indebted to the lecturer for giving us in a convenient and pithy form the salient features of the interior economy of a ship of war of the past. In the first page, the author says that we have, on the one hand, mastless turret-ships, and that we are in a stage of change. That is undoubtedly true; but while the ships are changing, our plan seems to be not to change our naval organization, so as to adapt it to the ships. There is one question I should like to ask the lecturer with reference to the passage in his lecture, in which he says, speaking of the past, "that many ships are reported to have arrived at a high standard of efficiency is due more to the Officers who commanded them than to any general system of organization or training." I would ask him, is not this statement as applicable to the present as to the past? In the passage in which he says, "With reference to the clothing and personal cleanliness of the men and their conduct at gun and sail drill, the Lieutenants are responsible through the Commander to the Captain," &c., Lieutenant Campbell here omits altogether any information about how the finance arrangements of the men are carried out. I think that is a very important matter, considering the very large sum which the Paymaster class costs. He says that the Lieutenants of division really have only to do with the clothing and personal cleanliness of the men. I have for many years held the opinion that a proper organization would, by a subdivision of labour connected with men's accounts, enable the Officers of division to do what is done in the Army—to deal largely with the pay arrangements of their divisions, and thus you would get rid of an Officer of the Paymaster class on board ships at a high salary, substituting combatant Officers with a little increased pay, as in the Army. That, I think, is a most important matter for discussion with regard to the interior economy of a ship. You have not too much room for Officers; you have only enough to fight the ship; and if one or two Officers are killed, you must be short and hard put to it. In the meantime, you have the Paymaster at high pay, taking the position of a combatant Officer. The question arises, whether by improving the organization of the Navy, you could not get more economy and increase the fighting power, besides bringing the Officers more in contact with the private characters of the men, which is a material point; and there is nothing where the private character of a man comes in so much as when you begin to deal with matters relating to his pocket. Then there is another point to which I should like to refer, and in regard to which there is a wide difference between the Navy and the Army. In the Navy your organization is not so complete, for this reason: your chain of responsibility is not perfect. For example, in the Army, the gradation of the punishment that an Officer can award descends with the rank of the Officer. You observe here that it is the Captain or the next in command who alone has anything to do with the punishment of the men. Now, the question is, whether, in the distribution of power of punishment, the chain of responsibility might not be better maintained by following somewhat in the same direction; so that for minor punishments, within certain limits, an Officer of division may exercise authority, higher offences going to the Commander, and still higher to the Captain. With regard to the petty officers in a ship—I am speaking from past experience, not having served in a man-of-war for many years—I know there is a vast difference between the reliability, in matters of discipline, of petty officers as compared with non-commissioned officers, and that a good deal arises from the necessities of a ship. I do not think that the petty officers on board a ship are made so material and important a link in the chain of responsibility as is necessary to keep up the real chain of discipline. Any improvement which can be effected in that respect, I think, would be advantageous. Then with regard to the Artillery and the Marine Infantry forming a proportion of a ship's complement, I admit that it was a necessity in the past; but I doubt whether it is at present. If it is a present necessity, I think it is because the country denies to the Navy the means and opportunities of that organization which would render it so far self-reliant as to be able, in ordinary times of peace, to do without a force on board ship which is wholly auxiliary, but actually kept serving in peace as an integral portion of the Navy afloat. As I said the other day, for every marine and artillery-man you keep three years on board ship, you are keeping probably a boy or an ordinary seaman three years in a harbour-hulk to learn the duties of a seaman there, because you cannot put him in a ship; there is no room for him. With

regard to Officers, I repeat what I have so often said, that I consider it is an enormous waste of money to educate Marine Officers and Artillery Officers to take up room on board ship doing practically nothing.

Rear-Admiral HORTON, C.B.: I should like to allude to one point mentioned by Lieutenant Campbell with regard to the future. I may be permitted to observe that the importance of the "circulating system" appears to me to be very great, and my principal reason for rising is to say that during the twenty years I have had nothing to do afloat, it did occur to me to suggest to the Admiralty that a system of circulating cruizers should be established, leaving this country at certain regular intervals, so as to enable the ships (that should be sent round the world) to visit the different stations, and to be there at certain points ready as reinforcements for any service that might unexpectedly occur, and to return home, bringing with them invalids or returned crews, very much upon the plan that Lieutenant Campbell has now proposed:—that such ships should be sent with the definite object of relieving the crews and training them in seamanship on the voyage. I would venture to suggest to Lieutenant Campbell, that if he endeavours to mature his plan at any future time, *two* ships should be sent together, and, if possible, two exactly alike, the better to provide for any accident happening to any part of the machinery, spars, or sailing gear of either. I think by that addition to the plan suggested by Lieutenant Campbell, an important element would be introduced into the Service, fulfilling many duties that are now required and would be further required with the revival of sailing in prospect, enabling the ships to be ready at the different stations at specified periods to act as a reinforcement under the Commander-in-Chief of each foreign station.

Lieutenant CAMPBELL: Admiral Luard referred in his remarks to my omission of the medical staff. That omission did not arise from my not thinking of them or my not appreciating their great usefulness on board ship. I thought that by the rules of the Institution I was limited to an hour for delivery, and to sixteen pages of the Journal, so after I had written my paper I had to cut out a great deal before putting it before you, so that I am afraid it has been placed before the Institution in not so full a condition as I should have wished. I had to leave out reference to Paymasters, medical Officers, and all except the executive Officers; and I hope that they will accept my apology for the omission. A question has been raised by Colonel Green with reference to the responsibility of the Navigating Officer. I suppose he means as between the Navigating Officer and the Captain? I am sure that every naval Officer present knows that that is about as difficult a question as can be asked at the present time, and I certainly would not take upon myself to answer it, except as an individual. I will give you my own idea of the matter, and give a short anecdote in illustration. I said in my paper that the Captain is responsible for all; and when I said it I meant it. In a ship of war the Captain is responsible for everything that has to do with her; either with regard to her movements from port to port, or to the interior economy of the ship, he is responsible and he alone. The Navigating Officer is responsible for the navigation of the ship under the Captain. There is a story of a ship going to Bermuda Dock, the Captain and the Navigating Officer of which, apparently, divided the responsibility between them. The Captain said, "It is a very narrow passage. I will take charge of the starboard side of the ship, and you can look out for the port side." When the Captain saw that his side was getting a little too close he ported his helm, got into a position where he had plenty of room, and said to the master, "I am all right on my side." "I am ashore mine!" said the master. So that the Captain looking after one side, and the master the other, the ship was grounded. I believe, with Captain Colomb, and I stated in my essay on "Training,"[1] that the time has come when Lieutenants can assist in financial matters; but not in addition to their other duties. With reference to fighting, every day that passes we find more and more that you want a whole heap of Officers who will be ready to take command immediately. The betting is very heavy—100 to 1—that the Captain will be killed on first going into action, and that the Officers relieving him will be killed in their turn.

[1] See Journal R.U.S.I., vol. xxvi, 2nd Essay, p. 250.

For that reason I believe in every Officer being a combatant Officer, thoroughly trained in tactics, and capable of taking command of one of Her Majesty's ironclads in a fleet action. That of course we know Paymasters and other Officers not combatant are not supposed to be capable of doing. I beg to thank you very much for the kind attention you have given to the paper which I have done myself the honour of reading to-day.

Sir F. NICOLSON: I should like to say one word in explanation of what Lieutenant Campbell has said with regard to the length of his paper. I do not think he occupied forty minutes in reading it, so that he still had a quarter of an hour to spare, and we are always disposed to allow a certain latitude, especially for valuable papers like his.

The CHAIRMAN: In proposing a vote of thanks to the Officer who has given us this very valuable paper, I may be permitted to make one or two remarks. I think that he has lost sight of one fact, viz., that in future in case of a naval war (which is, after all, what we must think of) we should not have altogether to deal with a continuous service of men and boys. The present number of men and boys is very limited, and in the event of a war we should have to man a great number of ships with recruits, and consequently our time would be very much more taken up than it is at present in drilling novices at great gun and other exercises. At the same time I would not for a single moment wish to throw a damper upon drilling aloft. I have often heard the remark, "What is the good of your reefing and furling sails or sending down a mast or yards, when in action in the future you will have mastless ships?" I think that is a very great mistake. Our masts and yards are, to all intents and purposes, a gymnasium for making our men muscular, and active and ready of resource, in fact to be, what I hope they are, British sailors. There was one remark made by Captain Colomb which I certainly did not expect to hear from him, and which I strongly object to. I do not think the time has arrived, and I do not think the time will arrive in the future, when we can do away with our marines and marine artillerymen.

Captain COLOMB: I did not say I would do away with them.

The CHAIRMAN: I understood you said they took up the place of other men. I should like to put on record that I most strongly feel that the time has not arrived when we can do away with all our marines. They are a very excellent body of men on board a man-of-war; everybody must do his own work. The old saying is true: "Everyone to his work, and the cook to the foresheet." The happiest ship will be the one where everyone does his own work; where the Captain exercises a wholesome influence over everybody, but does not take a bit of the boatswain's work, and a bit of the Commander's work, or the Marine Officer's; he simply sees that all under him do their duty. I beg now to propose a vote of thanks for the admirable paper which Lieutenant Campbell has given us, and to say how satisfied we ought to be, especially the older members of the profession, that those who are younger than ourselves are showing such aptitude in making themselves and others acquainted with the everyday routine of a profession which, without any derogation to the Army, is, after all, the mainstay of the British nation.

Wednesday, June 21, 1882.

CAPTAIN P. H. COLOMB, R.N. (Commanding Steam Reserve, Portsmouth), in the Chair.

THE NECESSITY OF SUPPLEMENTING ARMOUR-CLAD SHIPS BY VESSELS OF OTHER TYPES.

By CAPTAIN R. H. HARRIS, R.N.

MR. CHAIRMAN AND GENTLEMEN,—In availing myself of the privilege of addressing you this afternoon, on the necessity of supplementing armour-clad ships by vessels of other types, my object in so doing is not so much to enunciate my own particular views, as to provoke a discussion in this Institution, on the merits and demerits of our armour-clad ships, with reference to their capabilities of executing those very important duties, which will most certainly be expected of them, when we next have the misfortune to be involved in a maritime war.

Many persons, whom we cannot do otherwise than consider high authorities on such matters, when expressing their opinions in regard to the best means of adding immediate strength to the Navy, advocate the construction of armour-clad ships of great power; while others, who are also entitled to speak with authority on these subjects, throw the weight of their influence on the side of swift rams, or heavily armed fast gun-vessels. Again, there are people who are inclined to condemn all existing vessels, and construct the most formidable torpedo-vessels, in the belief that they will decide the issue of future naval battles.

Such being the somewhat conflicting opinions with which we have to deal, I do not think any apology on my part will be needful, for endeavouring to bring under your discussion the shortcomings of armour-clads, and introducing with some diffidence my own ideas as to the necessity of supplementing armoured ships by vessels of other types, believing as I do, that it is possible by adding a sufficiency of vessels of other types, in due proportion, to armour-clad ships, squadrons, and fleets, to increase their efficiency to a far greater extent than if the money these supplementary ships would cost was applied to the construction of one or perhaps two additional armour-clads.

To be able properly to approach and open up this subject for discussion, I must ask your indulgence while I make a short digression, which is, I think, necessary to lead up to the very commencement of the question, by, in the first place, determining what is the relative

power of armour-clads in comparison with the ships they have superseded, and with the power of the new forces against which they will have to measure their endurance and strength.

Since the absolute supersession of wooden line-of-battle ships by armour-clad vessels, driven off the face of the ocean as the former have been by the constant and rapid increase of the power of heavy guns, and the destructive shells projected from them, there can be no question but that the conditions of naval warfare have been as distinctly revolutionized as the respective types of war ships, past and present, have themselves changed.

Wonderful indeed have been these changes, and great is the diversity of type amongst the armour-clads themselves; so great indeed is this diversity, and so complex are the conditions which must be fulfilled to satisfy the requirements of perfection in an armour-clad, that it sometimes seems to me probable that these mighty monsters of the deep, which by the united talent and skill of the naval architect, engineer, and mechanic, have been made such splendid illustrations of armed science, were themselves in great measure on the eve of passing away into history, under the never yielding pressure of that relentless spirit of perpetual progress, which is the special feature of this most remarkable nineteenth century.

Nevertheless, the fact remains that we are in the possession of a costly armour-clad fleet, and in the event of war with another naval Power, this fleet will have to pursue, attack, or blockade the armoured vessels of the enemy. If this were all, we might perhaps rest content, well assured of success, but should we not be most imprudent to do so, resting as we should be on an almost untried article, liable to fatal attacks of a novel nature, which will leave the sole point on which the reputation of an armour-clad rests, viz., the immense thickness of armour and general impenetrability, entirely out of the question?

Before going any further with my subject, I must pause for a moment to explain as clearly as I am capable of doing, that, while endeavouring to point out the inefficiency of armour-clad ships, with the intention of demonstrating the fact that they require to be supplemented by other types of vessels, yet at the same time I have not the most remote intention of asserting that our noble armoured vessels are useless, or that any want of discretion, or error in judgment, has been shown in constructing them, or that we have built one too many of them.

On the contrary, I hold that the heavy armour and powerful ordnance which they carry may be on certain occasions of the greatest possible value.

But with your kind permission at this present time, I do wish most emphatically to assert, that the relative powers of the modern armour-clad and of the line-of-battle ship of the past are not, comparatively speaking, in anything like the same proportion, and that the comparison is very unfavourable to the relative power of the armour-clad.

Again, with your leave, it is my desire to add my voice, humble

though it may be, to the voice of those who have of late in this Institution repeatedly called attention to the rapid and startling changes that have taken and are taking place in all the conditions of naval warfare. Yet these changes, extraordinary as they are, seem only partially recognized by the country, and even then only in a general sort of way. Indeed the thought sometimes occurs to me, that we,—the nation whose prosperity, aye, and whose very life, is bound up with the mastery of the seas,—either do not care, or perhaps do not dare as a body to reckon what will in future occur, may be in our naval hour of need. But, instead, we prefer to live on in the vain and delusive hope that if we build as many and no more of the same classes of vessel as a possible enemy, arm them with the same guns, &c., then trust that as occasion may demand, the right men, the right ships, and the right tactics will be forthcoming at the right time, without further effort on our part; unwisely forgetful of the historical fact that although the decadence of the ancient maritime Powers may, perhaps, be traceable to the internal corruption of the nations, yet the departure of their naval supremacy has most usually resulted from the employment of some new type of vessel, or new method of attack, on the part of a rival hostile Power.

Bearing this in mind, I venture to say that, while we depend upon naval supremacy for our existence as a nation, it becomes our imperative duty to carefully examine any probable or prospective change in the conditions of naval warfare, boldly confronting possible changes before they arise, and giving them that serious consideration both in theory and practice which the paramount importance of the results must necessarily deserve, trusting, meanwhile, that our labours may keep us in naval matters far in advance of our possible foes, confident that the change or improvement, either in tactics or type of ship, may be on our side, and that the danger of having to face new ships under different or unknown conditions should rest with the enemy and not with ourselves.

To in some small measure approach this vital question, I must ask you to admit, or perhaps rather allow, for the moment, that our armour-clad ships of the larger types are the actual successors of our glorious old line-of-battle ships. Surely they are constructed to take the place of the latter, and both singly and collectively, in squadrons or in fleets, to fulfil the same functions, do the same duties, to carry our renowned flag, if not quite in the same fashion, at any rate in the same glorious and victorious manner, that their predecessors did in the hands of our forefathers. If we are not prepared to admit this, must we not be in error? For otherwise why should successive Administrations and Parliaments lavish such vast sums from the national purse upon the construction of our steel and iron monsters, were it not expected that they, in the hands of our Admirals and Captains, will maintain that same naval supremacy which has happily so long been the source of the honour and wealth of this country? And, again, if they are not the vessels with which we are to uphold the said supremacy, I ask with confidence what other class of ships have we at this present time in the Royal Navy that are capable of

doing more in time of need than help to protect our huge commerce? Have we any vessels which, independently of armour-clads, are capable of driving our possible foes off the high seas, and then, having done so, securely seal his ships in their ports of refuge? Has not this been done in the past, and will it not have to be done in the future, by that nation who dares assert her supremacy on the ocean?

Admitting, then, that our iron and steel clad vessels of the larger types are the inheritors of the glories and duties of our departed line-of-battle ships, is it not our obvious duty to examine their comparative efficiency and inefficiency for the work required of them?

Where we find efficiency let us gratefully accept the fact, where there is manifest inefficiency let us try and supplement it with the needful coefficient, always remembering that at present one armour-clad will have to take upon herself a far greater work than in the olden days five line-of-battle ships were thought capable of performing.

In support of this assertion, let me quote from the "Naval Chronicle" of 1799, where it gives the strength of the Royal Navy in June, 1798, as follows, viz.:—

Line-of-battle ships	188
Fifties	27
Frigates	217
Sloops	345
Total	777

Thus, in spite of the enormous increase of commerce, and the general increase of our national wealth during the last eighty years, we have now only some forty armour-clads to represent the 215 large and small line-of-battle ships existing at the end of the last century. Such being the case, is it not wise for us to closely inquire into the efficiency of our few armour-clads, and ascertain as best we can if they are able to competently take up the duties of the 215 large vessels of that day, aided as they were by 217 frigates and 345 sloops?

To determine this relative efficiency or inefficiency, it is necessary to speak separately of the merits and demerits of both the old and new types of vessel, and of the work they did and have to do. Granting, for the sake of argument, that what is appropriate to the single vessel will apply with nearly equal force to the squadron or fleet, sometimes with more, sometimes with less exactness, but always applying, we will turn first to the older vessels—the predecessors—now familiarly styled the old wooden line-of-battle ship. What proud confidence is expressed in the term line-of-battle ship! we have now our lines ahead, our bow lines, our quarter lines, our system of groups, but where is our line-of-battle? I fear it has succumbed, like its glorious prototype, to this restless age of steam, of iron and of steel.

Nevertheless, if she and it have succumbed, their glories have not; and history will relate far into the future how, when fairly manned and found, a line-of-battle ship might on her own element proudly and justly assume to herself a certain potency that is impossible to any vessel in the present day. She stood on her own merits, a floating

castle, the positive equal of all vessels not exceeding her in size; no less costly or inferior vessel dare face her gun-power, no submarine mine lurked on hostile coast, no insignificant vessel or torpedo-boat could under cover of night or fog attempt to blow a hole in her bottom; there existed no hostile ram which, under similar conditions, could water-log or sink her.

Uncertain as her motive power was, it was practically inexhaustible, fickle and fluctuating as the winds are, so long as they blew, they favoured friends and foes alike. A fresh supply of provisions and water, with a few days to caulk and refit aloft, put her into thoroughly efficient condition even after the longest of cruizes. When at sea, sailing east or west, north or south, increasing or decreasing speed, provided that the limits of her water and provisions were not too closely approached, no vital power was consumed. Her state was one of constant and immediate readiness for instant battle. No inferior enemy dare cross her ocean pathway, smaller foes sighting her, sought safety in flight.

Unsupported by frigate or corvette, sloop or brig, she was the proud and stately equal of any individual foe on the face of the broad seas or narrow waters.

How different is the position of her direct descendants, the large armour-clad vessels of the present day! I would that they possessed a like immunity from peril at the hands of inferior foes. Let me select a ship of the "Colossus" class merely as a fitting representative of a modern armour-clad, embodying as she does nearly all the vaunted ideas and warlike inventions of this eminently scientific age. She too, like her ancient compeer, has a potency of her own, and is capable of taking that potency in a given time and to a great distance with a speed and certainty, which to a line-of-battle ship would be outside the realms of possibility. And she, her coal-power and speed being unimpaired, possesses in an equal and comparative degree the power of fighting a successful action with an enemy of her own class. In like measure, during the daylight and clear weather, most smaller foes would wisely avoid her guns; and it must be freely admitted that, taken separately, all smaller vessels, be they frigates, corvettes, or sloops, if inferior in speed to herself, must become her sure and certain prey, *vide* Lieut. Madan's interesting communication to this Institution concerning the Chilian and Peruvian War, in vol. xxv, No. CXII of the Journal, in which he remarks as the result of his study of the naval operations of those nations, "that nations who choose to build their unarmoured corvettes or sloops with speed inferior to the ironclads of a possible enemy must expect to lose them."

But here I fear favourable comparison ends: every mile she steams, every preparation for action she may make, any vessel she may pursue, all hasten the necessity of a visit from a friendly collier, or a speedy return to a coaling station or port.

On a foreign and hostile coast the deadly submarine mine will lie in her path. There also will be the light and swift torpedo-boat, or a combination of these representing an infinitesimally small cost, both in

men and money, as compared to herself. Vessels confident that they hold, under conditions favourable to themselves, the power to destroy their costly foe, knowing themselves too swift to dread her pursuit, and possibly sure in their own minds that she would not imprudently empty her coal bunkers in a vain chase after them. Thus they might hover on her horizon, and so without making any actual attack, by keeping her in constant preparation for defence, much exhaust her steaming power, a process of exhaustion only to be relieved by her departure from the base of operations of her diminutive foes, or rough weather forcing them temporarily to seek shelter. But not this danger alone: under certain circumstances a determined attack by these small and swift torpedo-boats might, if well organized and made simultaneously by a sufficient number of them, be fatal to any armour-clad afloat even in the daylight.

To go beyond the single armour-clad, let me for a moment attempt to describe roughly the sort of attack to which a squadron of armour-clads cruizing off an enemy's coast would be liable, and then ask if there is not the possibility of its being in great measure successful. We will suppose an enterprising determined enemy, commanding a force of some twenty Thornycroft torpedo-boats. He has ascertained (how we need not inquire) the actual force and position of a hostile armoured squadron on some particular night, the weather on the occasion proving favourable to a torpedo attack. He issues orders to his torpedo-boat force somewhat as follows:—"From information I have received, I expect to find an armour-clad squadron of the enemy 50 miles north of Ushant. I contemplate seeking and attacking them about midnight. It is my direction that you are in readiness to proceed in company with me at 8 P.M. You will then weigh in company, and take each other in tow in order of seniority. It is my intention to steer to the north at 12-knot speed. The greatest caution is to be observed with regard to silence, all lights to be most thoroughly concealed and covered. It is my desire that any look-out vessels or guard-boats of the enemy should be most carefully avoided. But should they discover us and action with them be unavoidable, the four sternmost boats will cast off and endeavour at all costs, and regardless of hazard, to sink or capture them, parting company then and there from me, and returning to port at their own discretion.

"On discovering the enemy, you will by my order cast off and, forming line abreast, dash for him at your highest speed, acting independently of me and of each other, using your utmost exertions to successfully fire your torpedoes, which being expended, you will after the attack, having to the best of your ability supported each other, return to port also independently of me."

I pause here to ask if a squadron of armour-clads, when at sea and unaided, are efficient to successfully combat an attack of this nature. Those who know the condition of a squadron on a dark night at sea, and who have seen the uncertainty that ensues when two or three of its ships are thrown out of station, or the watchfulness and caution required during the performance of any manœuvre involving a large alteration of course, can best imagine the effect of twenty swift vessels

approaching, covering the mile that they could be seen, easily under four minutes. I much fear that electric lights, torpedo-nets, machine-guns, heavy armaments, and ponderous steel-faced plates would avail not to save many a torpedo shock, with its consequent destruction or disablement of some costly armour-clad.

Or suppose double the above-mentioned number of torpedo-boats concentrated with the view of attacking an armoured squadron by day, would they not even then be a serious danger?

Independently of these present risks on a hostile coast, signs are not wanting of the speedy introduction of a larger and more formidable class of torpedo-vessels, which, while equally excelling the speed of armour-clads, will be able to keep the sea with equal facility; vessels which will give the greatest scope to the ability of a daring and practical seaman, with good information concerning an armour-clad enemy, and possessing that overwhelming confidence and resolution which usually accompanies those who feel that they have the power of opportune and successful attack in their hands.

Contrast their position with that of an armour-clad foe, who may be either in perilous ignorance of the proximity of such dangerous enemies or harassed by the knowledge that he must await an attack from antagonists whose hand he can never of himself, through lack of speed, hope to force.

In addition to these coasting and sea-going torpedo-vessels, of which great numbers are sure to spring into life during the next great maritime war, it may, I think, be safely predicted that a very swift class of gun-vessel will come into existence, which need not aim at the very extreme speed of the torpedo-vessels, but, while still being constructed to outstrip the speed of armour-clads, will have their speed somewhat subordinated to the power of carrying a long-range gun.

These craft, like the torpedo-vessels, possess, by reason of their speed, the power and advantage of being able to select their own time and method for an attack on armour-clads. When we reflect how large a portion of our latest armoured ships is unarmoured and of the most fragile construction, we can realize that in a game of long shots the lighter, smaller, and least costly craft would not be the only sufferers.

In Sir William Armstrong's address upon our national defences he described some new light gun-vessels, as follows, viz.: "Light unarmoured ships have lately been constructed in this country to the designs of Mr. George Rendel, for foreign Powers, which, with a displacement of 1,300 tons, have a speed of 16 knots, and carry sufficient coal for steaming 4,000 miles; they are each armed with two new type 10-inch guns, capable of penetrating 18 inches of iron armour."

Here we have the beginning of such vessels, which if built to carry only one gun, might have a speed exceeding 16 knots, and thus be far more rapid than any armour-clad can hope to be.

Let us roughly estimate the probabilities of an engagement between a vessel like the "Colossus," and, say, four of these gun-vessels. Beginning with the monetary value, which seems the measure of most

things in the present day, we have here an armour-clad vessel, costing some 500,000*l.*, and with a crew of 400 men, and four vessels costing about 50,000*l.* each, and carrying a complement of 90 men. Then in the event of the "Colossus," by a well-directed fire, sinking one of her small opponents, and causing the others to withdraw, we have to estimate her success in this ratio—one vessel of 50,000*l.* value, manned by less than 100 men, *hors de combat.*

But should the fortune of war turn the other way, and these puny foes, by a few well-directed shells, inflict considerable injury on the weaker portions of their monster enemy, damaging her sufficiently to necessitate her seeking port, a not very improbable circumstance, we may then reckon the loss as 500 men and an engine of war worth half a million of money, rendered for the time unserviceable to the nation, who may have put too much trust in the power of an armour-clad ship.

The above argument would of course equally apply to an action between an armour-clad and gunboats of the well-known "Staunch" class, in so far as the destructive power of guns is concerned; but I would purposely refrain from quoting that class of vessel as any argument against the power of armour-clads, for the obvious reason that the very low speed of these gunboats must render an action with them entirely optional on the part of the armour-clad, while, if cleverly handled, she might, by her superior speed, destroy them one by one.

If any of the foregoing remarks as to the dangerous attacks to which armour-clads are exposed from foes hardly worthy of their supposed prowess be true, or even if they are possible contingencies, can unsupplemented armour-clads be pronounced efficient for our naval requirements? I think not. Then, if they are lacking in efficiency on some points, let us consider what is necessary for us to do, in order to, as far as possible, supplement them.

First and foremost of all supplements, we must arrange for perpetual relays of steam-colliers, some to follow and others to meet the armoured ships at certain specified rendezvous. It will be the imperative duty of an Admiral never to lose an opportunity of keeping each and every ship in his fleet constantly complete with coal.

Next we may take it for granted that it is a necessity to supplement every squadron with a steamer like the "Hecla," fitted to carry Thornycroft torpedo-boats and to be otherwise utilized as a general depôt for submarine mining and countermining stores. Steamers fitted for this service should be fast vessels, with the view of rendering their capture by the enemy improbable.

On foreign service it will also be a needful supplement to have a steamer for use as a factory ship; indeed, it will be generally necessary to supplement any considerable gathering of armour-clads with a steamer for this purpose, wherein large repairs of ironwork, &c., could be effected.

Independently of the above, let us, as a matter of vital importance, attach a co-efficient force in the shape of swift seagoing torpedo and gun-vessels in due proportion to the solitary armour-clad, and in greater numbers to the cruizing squadron or fleet of armour-clads.

Construct these vessels to largely exceed their mailed consort in speed and handiness. The proportion attached should not be less than two to each individual armour-clad, and at least three of these swift craft to every two armour-clads composing a squadron.

I do not feel that it is necessary for me in this short paper to go fully into details of these craft; it is more a question for naval architects. We as seamen must state our requirements for the particular class of vessel, and trust to them for the fulfilment of our ideas, only insisting that the maximum speed shall approach 18 knots an hour, and that they shall be seaworthy craft. I hope that by the employment of such vessels we may add that efficiency which is lacking in armour-clads, and which without supplement we cannot hope to restore.

The ordinary war duties of these swift vessels when attached to armour-clads would, in fair weather, be somewhat as follows, viz., some to precede the advance of their armoured consorts, while others should scour the seas on the bow and beam of the formation, overhauling strange vessels and collecting all possible information for the Admiral or senior Officer in command. These duties vigilantly carried out would render a surprise impossible, and the information daily collected might often prove of the greatest importance, while the sea cleared or covered by a fleet proceeding thus guarded, might, during daylight, exceed 25 miles in breadth.

Especially vigilant should these look-out vessels be at sunset, before closing in and taking up their station for the night, while at early sunrise they should spread fanlike to again take up with keenness their reconnoitring duties. Undoubtedly this would entail a considerable expenditure of fuel on the part of these vessels, they would require frequent coaling and occasional relief, but the value of their services would be, I think, quite commensurate with this expenditure, while it would most favourably compare with that of the armour-clads, had they to undertake any of these duties for themselves, to say nothing of the waste due to their monster engines being hourly kept in constant readiness for rapid increase of speed in case of surprise. While if, as before mentioned, swift vessels had searched their course well in advance, and with flanks carefully guarded, they might safely and leisurely proceed with fires low at an economical speed, thus preserving their coal endurance, and consequent efficiency, for a far longer period than otherwise would be possible.

It is hardly within the province of my subject to here go into the question as to what these swift look-out vessels should do on sighting the enemy, mainly depending as it would on the discretion of the Admiral, tempered by the information with which they have supplied him. But we may justly assume that whether employed to drive in or destroy the look-out vessels of the enemy, or ordered to fall back rapidly on their armoured consorts, their presence would be of no small value, even when their all-important look-out duties had terminated.

During the heat of future naval actions many a favourable opportunity will be afforded these vessels of using a torpedo with fatal effect, in the mêlée when armour-clad is attacking armour-clad in

deadly combat, when the air is charged with smoke and noise from the furious cannonade of heavy guns, the growling of Nordenfelts, the sharp crack of rifles, mingling with the roaring of escaping steam; amidst such din and confusion, who can over-estimate the value of numerous swift vessels, each capable of wreaking fell destruction on the largest armour-clad?

Not least in importance in the value of small swift vessels when employed as the supplement of armour-clads, will be the power they will give a Commander-in-Chief of rapidly sending his orders, when there is any difficulty in conveying them by signal, a point clearly pointed out by Lieutenant Charles Campbell, R.N., in his very interesting paper "On Signalling and Conveying the Orders of a Commander-in-Chief in Action," recently read in this Institution.[1] His remarks at that time render it unnecessary for me to say much as to the extraordinary value of having swift vessels, wherewith an Admiral could rapidly despatch important orders from ship to ship. At the finish of a hotly contested battle they would be invaluable to pursue and harass the light vessels of the enemy, also to track and mark down an escaping armour-clad foe. One or two swift vessels would be immediately despatched with news of the action to the nearest friendly port, or hurried off with timely warnings in case of a reverse.

During the blockade of a port in which it may be necessary to confine armour-clad enemies, small swift vessels would be of infinite service. Outside the lines of torpedoes they would be employed watching the entrance of the harbour, leaving their armour-clad consorts well out in the offing, beyond the reach of ordinary torpedo-boat sorties at night, sure by day of receiving speedy information of any movement on the part of the enemy.

A blockaded force would also be harassed by the knowledge that all sorties made by them must first evade these swift look-out vessels, and that even if successful in doing so, they must run a dangerous gauntlet when returning to port.

I confidently submit that the blockade of a harbour conducted in this way, viz., by an armour-clad squadron supplemented by swift torpedo and gun-vessels, would be far more effective and much less costly and hazardous, than if an unsupported fleet of armour-clads cruized off the entrance, in the same manner that fleets of their predecessors, the wooden line-of-battle ships, were wont unconcernedly to do.

At the very commencement of a war with any neighbouring Power, and during its continuance, vessels of the above types detached from their armour-clads should be employed to scour the Channel, daily issuing from Dover, Spithead, Portland, Plymouth, and other harbours; in the Mediterranean, in the same way, the daily cruizing of these swift vessels, supplemental to armoured ships, would more effectively establish and hold our naval supremacy in these waters, than the more cumbrous and expensive cruizing of an armour-clad fleet.

By employing swift vessels for this service we should realize the

[1] See Journal, vol. xxvi, No. CXIV.

wonderful factor that high speed will be in all naval operations of the future; these vessels, allowing them only to steam 12 knots when thus employed, are capable, during twelve hours of daylight, of clearing a circle of 144 knots' circumference round their base of operations, or of steaming twice round a circle of 24 miles' diameter during the same time.

It may be urged that many of the duties which I here propose to allot to swift seagoing torpedo and gun-vessels might be undertaken by the torpedo-boats carried by most armour-clads. I am quite willing to admit this to be possible, but it must be done under very exceptional circumstances, such as perfectly smooth water, with convenient shelter near, for which the torpedo-boats could make in the event of sudden bad weather.

However, in any case, the comparatively low speed of these boats, and their inability to take care of themselves if separated from their ships, would prevent their services being so thoroughly reliable as those of larger vessels capable of an independent existence. On many occasions it may easily be conceived that the separation of these craft from their respective ships would be a source of anxiety, rather than a protection, to the Officers commanding the armour-clads to which they belonged.

Some of the above arguments will not hold good if the torpedo-boats were carried by and attached to a special torpedo-ship like the "Hecla," from whom they might probably be more advantageously employed.

Very possibly it may be urged that the look-out and reconnoitring duties before-mentioned might be effectively carried out by our corvettes of the swifter classes; it may be so, but would it not be far more costly? Their consumption of fuel is great if pressed at high speeds, and are we justified in presuming that the services of such vessels could be spared from their more natural duty of protecting our ocean highways; a very improbable contingency if we were at war with an enterprising country?

Without doubt powerful tugs and other similar fast steamers could be purchased in considerable numbers, immediately after or just before a declaration of war, and these could be attached to armoured ships: this I understand was done by Sir Geoffrey Hornby, when ordered with his fleet up the Dardanelles. Very useful indeed might some of these craft prove, but as a body they must have many disadvantages, and could only be classed as makeshifts when compared with the specially constructed vessels now proposed.

In proof of the urgent necessity of employing numerous and swift look-out vessels, even when the movements of hostile fleets were slow and governed by the winds, let me here make three quotations from Nelson's despatches referring to his great want of frigates, employed as they were in those days as swift look-out vessels. Writing on June 29, 1798, to Lord St. Vincent, some little time before the battle of the Nile, he says, "Here[1] I had deeply to regret

[1] "Nelson's Despatches," vol. iii.

my want of frigates, and I desire it may be understood, that if one-half the frigates your Lordship had ordered under my command had been with me, that I could not have wanted information of the French Fleet."

Not a month after, on the 20th July, 1798, in another letter to Lord St. Vincent, he writes, "Yesterday I arrived here, where I can learn no more than a vague conjecture that the French are gone to the eastward. Every moment I have to regret the frigates having left me, to which must be attributed my ignorance of the movements of the enemy." Again, in the postscript of a letter to Sir William Hamilton, dated "Vanguard," 23rd July, 1798, he writes as follows:—"No frigates! to which has been and may again be attributed the loss of the French Fleet."

Surely Nelson's wants must here be a lesson to us, to supplement our armour-clads with frigates or vessels swifter than themselves, to perform those duties which our great Admiral expected of his frigates. Then our frigates being avowedly too few and too costly for this work, ought we not to construct many swift vessels wherewith to replace them? feeling confident that the cost of their construction would be money well spent, and that independently of the greater efficiency, I had almost said protection, thus given to our armour-clads, would return us their value in full; also satisfied in our own minds that even in the event of a lesser war, when the armour-clads might not require their services, yet, that we could still turn these swift vessels to good account, by letting them loose over the wide-spreading ocean paths of our commerce, to convoy and protect our own ships, and to harass, burn, and capture those of our foes.

In conclusion, I would again say that it is my desire to submit for your consideration and discussion the question, whether in most, if not in all, the circumstances to which I have somewhat feebly endeavoured to direct your attention, small vessels of very high speed, capable of accompanying an armour-clad fleet, might not be a valuable supplement to that fleet, and otherwise be of the greatest service to the State?

Admiral Boys: Captain Colomb and gentlemen: I did not happen to be present when the lecture commenced, and really I find it difficult to open a discussion on the subject, as what Captain Harris has told us seems to be so evident, and he has pointed out so graphically the cases in which our armour-clads may be placed before an enemy's port, or even at sea, by the sudden attacks of swift vessels and gun and torpedo boats, that he seems to have left us hardly anything to say on the subject. I may, however, observe that I think he has given us a little too highly coloured a statement as to the conditions likely to result from this attack when made, because I consider that the chances are not so much in favour of the small vessels attacking a large armoured ship as he represents. I recollect Sir William Armstrong in his introductory address to the Civil Engineers, told us what Captain Harris has repeated, and he implied that three or four of these fast unarmoured ships were more than a match for a regularly constructed armour-clad. I do not quite agree with Sir William Armstrong in that respect, though I do agree with him as to the value of this description of vessels for certain purposes. I think in a direct attack upon armour-clads by small craft, the chances are in favour of the armour-clads. Captain Harris allows that the armour-clad may sink one out of four; but I think it more probable that she would sink three out of the four, or all four, because they are so

extremely vulnerable. One shot in nearly any position would disable or sink them; and one well-planted shell from a long-range armour-piercing gun would settle them. The same applies to an attack by gunboats. Some years ago we built gunboats of the "Staunch" class, to which he refers. No doubt they have their value, especially for the defence of ports; but for attacking armour-clads at sea I do not think them well adapted. There is one point which Captain Harris has not pointed out. You must recollect that the guns in these gunboats, although of the same calibre as in the armour-clads, are fixed in the boat, and are pointed by the steering of the vessel. More than that, a gunboat from its small size is much affected by the sea. The motion is considerable when the large vessel has a steady gun platform, the difference is much the same as shooting at a flying and shooting at a fixed object, only in a gunboat the gun is flying as well as the object. Still there is an actual necessity for us to supplement our fleets with vessels of something of the "Hecla" class—perhaps a little faster—and also gunboats and torpedo-boats. With regard to the "Hecla," although she is not speedy enough, she is an extremely valuable class of vessel. She not only carries numerous torpedoes and eight torpedo-boats, but she can carry 2,000 tons of stores. I myself went out in the "Hecla" to the Mediterranean with my flag up. During the ten days' passage to Malta we had a gale of wind against us, and a gale in our favour; and we only expended 200 tons of coal, while the ship had 2,000 tons in her when she left England. I think we are all deeply indebted to Captain Harris for bringing the question forward; and I think, from his showing, we must acknowledge that the supplementing of armour-clads with different descriptions of light vessels is a necessity at sea in war time.

Captain SEYMOUR CURTIS: I should like to ask one question. Can anybody tell me whether there is a single ironclad in the fleet of the present day which could start from Cork and steam straight to the coast of America, and have sufficient coal in her bunks then to be of the slightest use?

Admiral BOYS: It depends on her speed.

Captain SEYMOUR CURTIS: Let her make the best speed she can. With regard to the question of the shooting of the small gunboats, I was commander of an ironclad for two years and a half, and we fired away many hundred shots, and only hit one target. It is very hard to hit anything with an 80-ton gun at more than 500 or 600 yards.

The CHAIRMAN: I am afraid nobody has any further remarks to make, and so I must offer the lecturer the thanks of the meeting. I am sure the audience, small as it is, will very heartily join me in thanking Captain Harris for the very excellent paper we have listened to. Captain Harris must not judge that the size of this meeting has any relation to the importance of his paper. As a matter of fact, the paper he has read to-day is, I have reason to believe, the keynote of the ship-building policy of the day. I know it is one of those questions on the determination of which, either one way or the other, hinges our ship-building policy, perhaps for the next two or three years. It is a question which must be debated at the Admiralty, and which was raised by Mr. Barnaby at the Naval Architects four years ago. I have some figures here in a paper which, though marked "confidential," is not confidential as to facts, and I am at liberty to make use of them if I think proper. In these days, when cost has so much to say to it, I think that the table I am about to read has an important bearing on the paper we have just heard. One ironclad, carrying 500 men, will cost 500,000*l.*, and will carry 600 tons of fuel, and, say, two torpedo-boats. Six unarmoured ships, with 1,800 men, will cost 900,000*l.*, will carry 6,000 tons of fuel, and 24 torpedo-boats. Six torpedo rams, carrying 700 men, will cost 900,000*l.*, carry 1,200 tons of fuel, and no torpedo-boats of course. That force would be represented by 3,000 men, would cost 2,300,000*l.*, and carry 7,800 tons of fuel, and 26 torpedo-boats. On the other side, six ironclads, carrying 3,000 men, would cost 3,000,000*l.*, would carry 3,600 tons of fuel, and 12 torpedo-boats. The writer of the paper is strongly in favour of supplementing each individual ironclad by a force of light ships, such as the lecturer has described. I was very much struck myself with Captain Harris's statements as to the use of light ships attached to ironclads in the open sea in time of war—the enormous circle which can be swept by a few light ships of very great speed in a

very short time; and the great importance in the way of saving of fuel that this would be to any fleet that had them attached to it, enabling the ironclads to rest quietly with very low fires, knowing that long before the approach of a hostile fleet they could make their dispositions, get steam up, and have everything ready. Nothing but light swift ships could do that without an expenditure of fuel not to be thought of. I was also struck with the use of the light ships attached to an ironclad fleet in case of blockading. Of course a blockading fleet can be driven off now by means not dreamed of in the old days. The torpedo-boats and torpedo-vessels, with the Whitehead torpedo, will be a terrible matter for an inshore squadron to face. It seems to me that an inshore squadron now must be represented by some light ships as look-out ships, such as have been described. I think what the lecturer wants to do really is to get us to establish in our minds as a principle that the ironclad is not to be, as a rule, unaccompanied by consorts of this light kind. That is the point. We know that our naval policy is tending towards that. The building of the "Iris," the "Mercury," and other ships of the same class now in process of construction, show us that that idea is already afloat, so to speak. I must say I do not know that I ever read a paper which pleased me so much by the nature of its diction, and the clear way in which the statements are made; and what the lecturer wishes to impress upon us is that we should carry in our minds the necessity of always looking upon the ironclad as a fighting citadel, as it were; to be surrounded by light earthworks, which are to be the guards, to be destroyed, so to speak—if they are to be destroyed at all—before the main attack comes. There would be the light line of skirmishers, who would commence the attack, to be followed afterwards by the heavy ironclads. I am sure that by and by, in a year or two, this paper will be referred to as giving a starting point to the policy of the future; although, myself, I am not quite prepared as yet to desert the simplicity of the old serried rank of the ironclads, one astern of the other, for making a solid attack. But, of course, opinions differ. I am quite sure you will all join in a hearty vote of thanks to the lecturer for his most admirable paper.

Friday, January 19, 1883.

VICE-ADMIRAL H. BOYS, Member of Council, in the Chair.

THE LAY AND OTHER LOCOMOTIVE TORPEDOES CONSIDERED FOR THE PURPOSE OF COAST DEFENCE, AND ALSO AS THE ARMAMENT OF SHIPS, TORPEDO AND SUBMARINE BOATS.

By Lieutenant C. SLEEMAN, late R.N.

IN discussing this question of the employment of the Lay locomotive torpedo for general service, it will be necessary first to briefly describe the other torpedoes of this nature that at present exist, and point out their advantages and disadvantages.

Locomotive torpedoes, that is, submarine weapons which possess within themselves their power of locomotion, may be divided into two distinct classes:—

1st. Uncontrollable locomotive torpedoes, that is, those which cannot be controlled or directed at the will of an operator.

2nd. Controllable locomotive torpedoes which are under an operator's control.

The latter class may be further divided into controllable locomotive torpedoes requiring special appliances for maintaining their motive power, and fixed stations or specially fitted vessels or boats to manœuvre them from, and torpedoes of that nature which act independently of such.

In Class I, I place—
The "Whitehead" fish torpedo.
In Class II (A), I place—
The "Brennan" torpedo and
The "Ericsson" (tube) torpedo.
And in the same class (B)—
The "Lay" torpedo.

CLASS I.—*Uncontrollable Locomotive Torpedoes.*

Of this class the Whitehead stands alone, and is decidedly *par excellence* the most perfect torpedo of this kind that exists at the present time, or is likely to be invented.

The highest speed attained by the Whitehead is, I believe, 26 knots for 200 yards, $23\frac{1}{2}$ knots for 400 yards, and 18 knots for 800 yards. In calm weather and in places where no tide or current is experienced this torpedo may be discharged with accuracy at a distance of 500

yards, even when the vessel using it is proceeding ahead at the rate of 17 knots per hour; but to effect such good practice very great experience is necessary in adjusting the torpedo. Practice with this torpedo by men who are not experts would not be attempted with a vessel at a speed greater than 10 knots per hour, and then under favourable conditions there is fair certainty of hitting a moving vessel at the distance of 300 to 400 yards.

The mere fact of its having been universally adopted by the principal naval Powers entitles the Whitehead to be highly considered, but in the hands of those who would have to manipulate it in time of war it seems to require too careful adjustment, and too many niceties of calculation, as to the distance and speed of the vessel aimed at, to prove as reliable as it is absolutely necessary such a weapon should be under the peculiar conditions met with in actual war.

The advantage of the Whitehead are that up to its limit of accurate range (500 yards) it is entirely self-acting—that is, that the vessel using it, when once a Whitehead has been fired, has nothing further to do with it, and also its great speed for this distance of 500 yards, which it only takes some forty seconds to cover.

The disadvantages of the Whitehead are—

1st. Its limited accurate range (500 yards).

2nd. The complicated nature of its adjustments.

3rd. The necessity of discharging it from special apparatus.

It is possible to start the Whitehead from above water, but then its inaccuracy is so seriously increased as to render this method comparatively useless.

4th. Its comparatively weak power due to the small charge of explosive carried.

The charge for the large 15-inch Whitehead of 19 feet in length is only 80 lbs., while that for the 14-inch one of 14 feet in length is only from 30 to 40 lbs. of gun-cotton.

5th. When once started the course of the Whitehead cannot be altered to meet any sudden change in the direction of the vessel aimed at, and also it must be set so as to sink at the end of its run on actual service, so as not to remain floating about to the detriment of friends as well as of foes.

And when practising with this torpedo it must be set to float at the end of its run so that it can be recovered, which has not been always successful.

In Germany, Whitehead torpedoes are constructed by Messrs. Swartzkoff and Co., which only differ from the real Whiteheads in that their cases are formed of phosphor-bronze in the place of steel, the object being chiefly the reduction of cost.

In summing up the merits of the Whitehead torpedo, it may be considered a very powerful weapon, and under favourable conditions is fairly accurate up to a range of 500 yards, either as a ship weapon, or when used from the shore for harbour and river defence, or as the armament of torpedo-ships and torpedo-boats.

The German Government have made some experiments, I believe, with sunken batteries containing several Whiteheads discharged from

the battery by electrical means under the control of those on the shore batteries. By this means it is intended to increase the present limited range of those torpedoes. What success has ensued I am unfortunately unaware of. Here the direction in which the Whitehead would be fired remains constant, and therefore this method could only be used when the enemy's vessel had reached a certain position, and also only in ports where little or no tide or current is experienced, and where a shelving shore running out under water a long way admits of the sunken battery being placed.

CLASS II (A).—*Controllable Locomotive Torpedoes.*

Of this class there are two representatives, and of these I will first discuss the Ericsson controllable locomotive torpedo.

This weapon has for its motive and directive power compressed air, which is pumped into the boat through an india-rubber tube of 1 inch diameter, and is thus supplied to the engines and steering gear. The india-rubber tube is unreeled from the shore as the torpedo moves ahead.

The disadvantages of this Ericsson torpedo are principally—

1st. The employment of a flexible tube, which by fouling prevents any or the proper supply of air being maintained.

2nd. Owing to its size a great length of tube cannot well be dragged out, and therefore its range is very limited.

3rd. It has to be manœuvred from stations or vessels specially fitted with apparatus for pumping in the compressed air.

4th. Its want of speed, due to the work required to be expended in dragging out the tube.

This torpedo has been tried in America, but has otherwise not been brought into public notice, and its trials there were not successful.

I now come to the Brennan controllable locomotive torpedo, which is an Australian invention, and which has been lately experimented with at Chatham.

The Brennan may be termed a "mechanical" locomotive torpedo, that is to say, it is moved ahead and steered entirely by mechanical means.

The mode of propulsion adopted in the Brennan is that of connecting the shaft of two drums placed in the body of the torpedo to its screw shaft, so that on the unwinding of the fine wire previously reeled up on those drums, the latter are made to revolve, and imparts in turn a revolving motion to the screw. To perform this work it is necessary to have a steam-engine and two reels at the directing point, which reels being revolved wind the wire from off the drums in the torpedo, whereby they and the screw are revolved and the torpedo moved ahead. The steering is effected by increasing or decreasing the velocity of either of the short reels, which imparts motion by means of tiller ropes to the rudder. The wire used is similar to the steel wire employed by Sir William Thomson in his deep-sea sounding apparatus. The torpedo is directed by means of a steel telescopic mast carrying a pennon.

The torpedo, according to Mr. Brennan's patent specification, can be

run at different depths by an arrangement somewhat similar to that used in the Whitehead torpedo.

In the Chatham trials I believe that a speed of 14 knots per hour was obtained, but for what distance I am not informed, and it was considered to be controllable up to about 1,200 yards; here, again, I am unable to state what was the nature of the experiment instituted to prove this fact, nor am I able to inform you as to the size or the weight of the torpedo tried there, or its explosive capacity.

In the afore-mentioned specification Mr. Brennan very modestly claims for his torpedo, 9 feet in length and weighing 3 cwt., a speed of 6 or 7 miles per hour for a distance of 300 yards.

A torpedo of those dimensions could not carry a sufficient amount of explosive compound.

Four times the amount of wire must be coiled on the torpedo drums for the distance that it can run; for instance, for a $\frac{1}{2}$ mile run, 2 miles of the wire would have to be reeled up.

The advantages claimed for the Brennan torpedo are—

1st. Great simplicity.

2nd. Its small cost.

Its disadvantages are—

1st. The necessity of working it from a fixed station or stationary vessel, where is placed the steam-engine and winding-up reels.

2nd. The risk of a kink occurring in either of the wires, which, on any strain being brought on the kinked wire, would most certainly snap it in two.

3rd. Its apparent want of range. I believe it is capable of being steered with some certainty up to a distance of 1,000 yards.

4th. The fact that the wires must lie very near to or on the surface, and therefore might be got at by the enemy, or damaged by the passage of a friendly ship or boat.

5th. That the fouling of one or other of the two wires with any obstacle in the path would disable the torpedo, and probably break the wire so fouled, by reason of the great speed at which it must be dragged through the water in the process of unreeling the wire from the torpedo and reeling it up on the shore drums.

6th. Its directing mast is not lowered or raised at will, and therefore remains up during the whole of its run. The mast can be forced down when meeting with any obstacle, and when free at once resumes its upright position.

7th. Its having only one mast to direct it by, which must seriously militate against very accurate aim being obtained.

8th. It cannot be steered back to the point it is started from, but must be dragged back by its wires.

I must here state that I have never seen the Brennan torpedo in practice, but have stated its merits and demerits as they appear to me from information I have been afforded by those who have actually witnessed some of the trials made with it in Australia and here, and also from a study of Mr. Brennan's patents, and, therefore, some of my surmises may possibly be wrong, if so, I shall be only too pleased to be corrected on those points.

CLASS II (B).—*Controllable Locomotive Torpedoes.*

In this class there is at the present time only one torpedo, viz., the "Lay Controllable Locomotive Torpedo," which does not require to be manœuvered from any fixed station or specially-fitted vessel or boat.

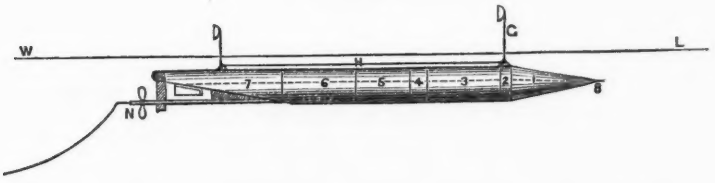
In affording a description of the Lay torpedo, I take as a specimen the one I have personally assisted to take to pieces and fit up, and also helped to manœuvre on two trials made with it by the Imperial Ottoman Government, only some few months ago; and which same torpedo has been successfully experimented with in Russia and Belgium.

Besides this one, there is the improved type of Lay, ten of which were built for the Russian Government by Colonel Lay, and all of which were entirely successful.

In addition to these Lay torpedoes there is another one nearly completed, which will embody many important improvements, even on the Russian design, and have a speed of at least 14 miles per hour.

The Lay torpedo I propose to explain here, of which a sketch is shown in Diagram 1, is constructed of steel of $\frac{1}{8}$ inch thickness, and is divided into three distinct sections, viz., the bow section, the reservoir section, and the after section. The total length over all is 26 feet, its maximum diameter is 24 inches, and it weighs when completed loaded about $1\frac{1}{2}$ tons.

DIAGRAM 1.



The Bow Section is divided into two compartments, viz., the magazine and the guide-rod compartment.

1. *The Magazine.*—The amount of explosive carried in this type of Lay torpedo is 90 lbs. of dynamite; in the Russian Lay torpedoes it is increased to 150 lbs., and the same amount or more will be carried in the improved one now being constructed; at the same time neither the length or weight of these Lays is increased.

The charge can be exploded either "at will" or by contact.

In this chamber is arranged a device whereby the blow of impact on the torpedo striking a ship is taken up by the pressure of a piston on a cushion of water.

The magazine in this torpedo was fixed, but in the Russian type and in the new torpedoes the magazine will be arranged to drop automatically on impact a distance of 7 or more feet to the end of a small

chain or wire rope, and explode by mechanical means at the moment of reaching this depth.

2. *The Guide-rod Compartment.*—Here is contained the apparatus for raising and lowering the foremost guide-rod marked G, which can be performed at any time at the will of the operator.

The Reservoir Section.—Here is contained the motor of the Lay torpedo, which is carbonic acid gas (represented by the chemical formula CO^2).

The After Section contains the balance, cable, engine, and steering compartments.

1. *The Balance Compartment.*—Herein is contained an ingenious device whereby a certain portion of water is allowed to flow in to counterbalance the weight of gas expended during the run, and so arranged that on stopping the torpedo the flow of water ceases.

2. *The Cable Compartment.*—Here the electric cable of the torpedo is stowed, by which the various functions of the torpedo are directed by the electric current flowing along it.

This cable is formed of four insulated cores braided over, and the weight of 1 mile of it is only some 260 lbs.

In the Lay torpedo used at Constantinople, and which I am now describing, the directing end of the cable was led out of a tube running through the hollow screw shaft and brought out well clear of the screw, as is shown at N in Diagram 1.

Colonel Lay now adopts the plan of running the torpedo cable directly out of the bottom of its compartment, as is shown in Diagram 4.

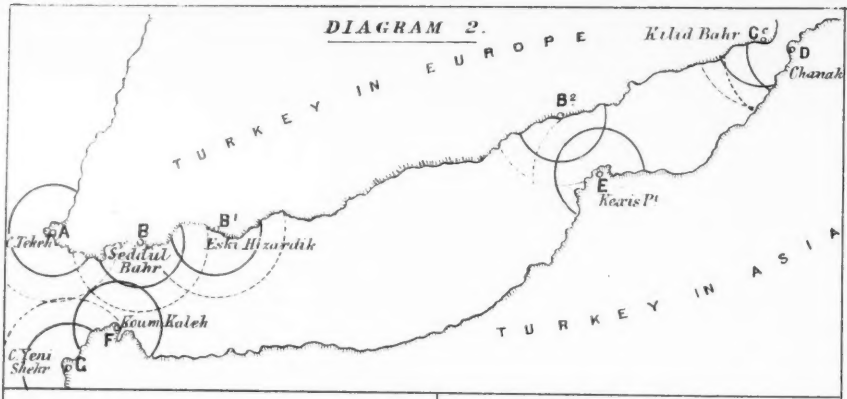
3. *The Engine Compartment.*—In this chamber is fixed the machinery for working the screw.

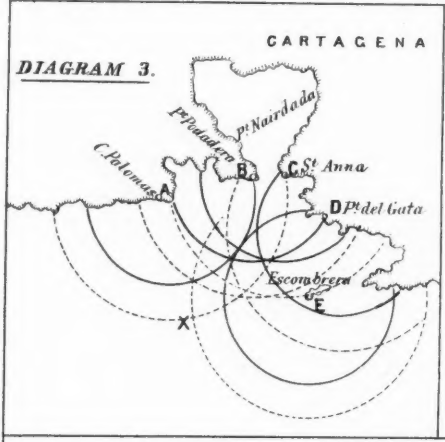
4. *The Steering Compartment.*—Here is contained the apparatus for moving the rudder to port and starboard at will of the operator.

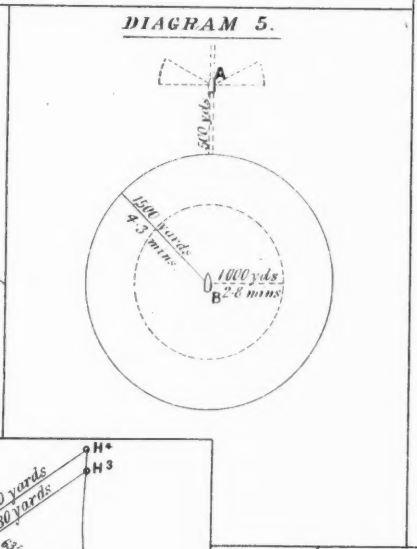
The Guide-rods.—These are two thin iron rods, hinged the one on the fore part, and the other on the after part of the back of the torpedo, and as I have previously explained, these can be raised and lowered together at will. Each is provided with a disc for day runs, and a small oil lamp for night runs—the foremost disc being painted red, and the after one white, on their rear face, the front of them being painted black or grey. That is to say, the side of the discs facing the enemy would be painted the colour which experience has proved to be most difficult to discern, that is, black or grey; and the side of them facing the operator would be painted the two opposite colours most easily discerned, such as red and white.

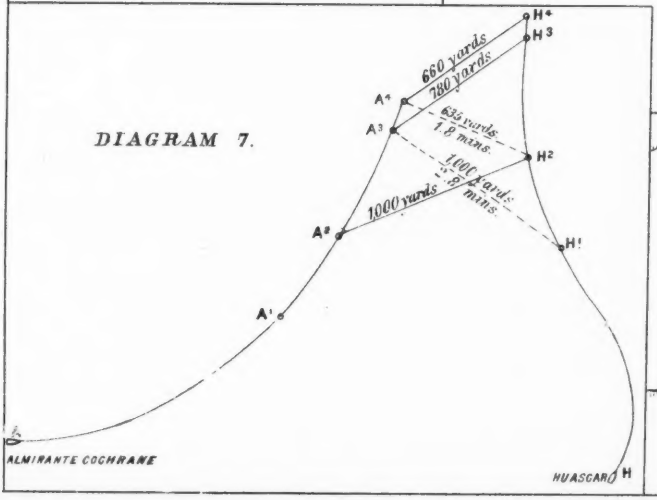
These discs are detachable, and for night runs are replaced by lamps, which are shrouded in thin brass hoods, and are so pivoted on this hood that when the guide-rods are lowered, the face of the lamps lie on the torpedo. By this arrangement the lamps can only be seen by the operator, and not at all by the enemy, whether the guide-rods be up or down.

In day runs the torpedo can be brought back to the point it started from, as the sketch of the Constantinople trial shows—but at night time such cannot be very well done, unless, as it has been proposed, the









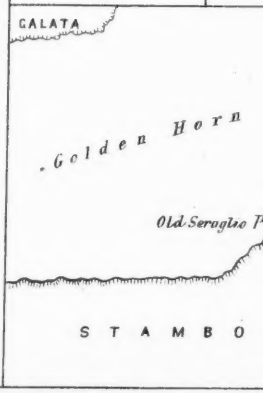


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DIAGRAM 6.

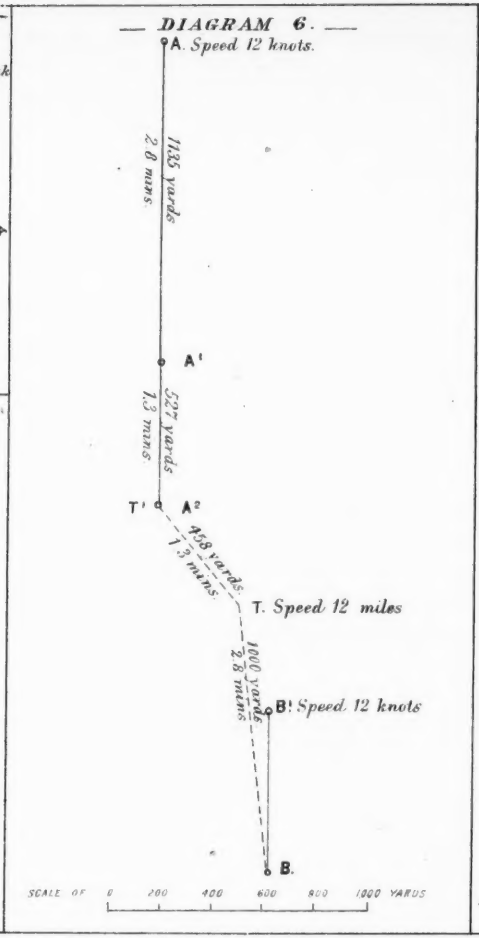


DIAGRAM 8.

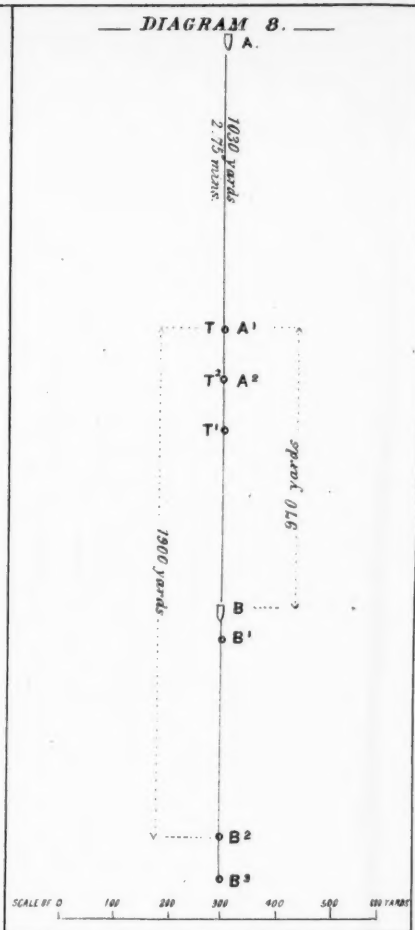
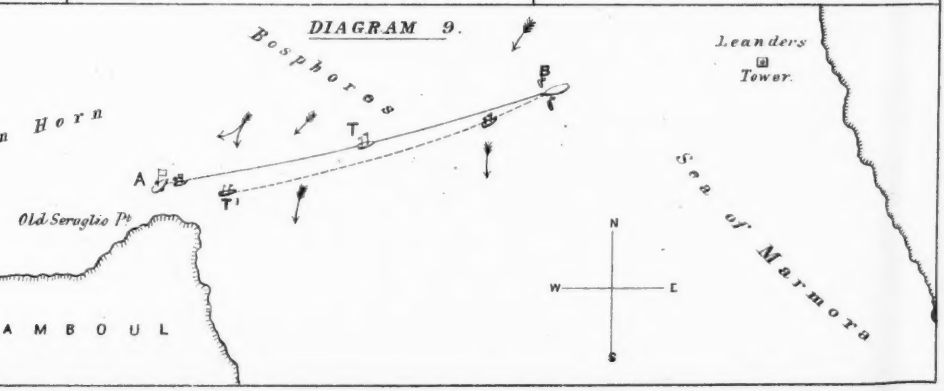


DIAGRAM 9.



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rods are arranged to be turned round at the will of the operator: such could be effected, but the question is, whether it is needed on actual service or not.

The guide-rods in the new Lay torpedoes will be placed on the side, so that when lowered they will not be liable to be exposed when the torpedo is at rest, or create any disturbance of the surface as the torpedo speeds along.

The Key-board.—This consists of a small box about 18 inches by 12 inches by 4 inches, which contains the ordinary electrical mechanism for the purpose of throwing in and out of circuit different currents, by means of keys worked on its upper surface.

In manipulating the torpedo, it would usually be only necessary to pay close attention to the steering key, after once the torpedo has been started, and the guide-rods raised; and the method of firing by contact would be the one usually adopted.

There now only remains to be noticed the "Battery" which generates the electricity by which the various functions of the torpedo are directed.

This may be any form of voltaic battery which will afford a sufficiently strong current, combined with portability.

Then to direct the torpedo, the operater has only to give the same orders as when steering any ordinary boat; key S being moved according to the order.

The operations of "stopping and starting the engines," "raising and lowering the guide-rods," moving the rudder to "port and starboard," can be performed at any time at the will of the operator during the run of the torpedo, as well as the firing of the charge at will.

I will now state what are the principal advantages of the Lay torpedo.

1st. It is perfectly controllable up to any distance equal to the length of its cable.

2nd. Its great range, which is only limited by the size of the torpedo, and the distance off at which the guide-discs may be kept in view by means of powerful binoculars. The range at present for the larger Lay torpedoes intended for harbour defence is $1\frac{1}{2}$ miles: for the smaller torpedoes to be used in ships and torpedo-boats, the range is $\frac{3}{4}$ to 1 mile.

3rd. Its speed of 12 to 14 miles per hour, for the whole length of its run.

4th. Its complete invisibility when the guide-rods are in the lowered position, due to the torpedo being then submerged at least 9 inches, and there being no disturbance visible on the surface as it moves along.

5th. Its great power due to the heavy charge of explosive carried; the amount ranging from 100 lbs. of dynamite for the ship torpedo to 150 lbs. or more, according to its size, for the harbour defence torpedo.

6th. Its extreme portability, that is to say, as the Lay does not require any apparatus for discharging it, the torpedo may be

manœuvered from any place where a body weighing 1½ tons can be conveyed to, or from any ship or boat which can hold the battery and operators. It can be moved from point to point on shore, either by rail, or by an ordinary wagon, or special carriage drawn by horses or men.

It can be conveyed by any ship by hoisting it up to one of her boat davits (strengthened if needed for the purpose), or to improvised davits in a steam-tug, &c., as was used at Constantinople, or to specially constructed davits in a torpedo-ship or boat; or it may be simply towed by any craft, whether a steamer or a rowing boat.

Thus it would always be a matter of uncertainty to a blockading or bombarding force from what direction an attack by the Lay torpedo might be made. Again, the Lay may be used from any ship or boat at a moment's notice.

7th. It may be operated from a ship or boat without impeding her movements. A separate cable, coiled as in the torpedo, will be carried in the craft from which the Lay is to be manœuvred and connected up to the torpedo cable, by which means that craft may proceed as she pleases after starting a Lay, without dragging the cable out of the torpedo.

8th. It may be anchored or stopped with a break on its cable, to prevent it running out in a current or tideway, or while it drifts when stopped. The anchor will be slipped on putting the rudder over; the break will be taken off the cable on the engines being started, or put on the cable when the engines are stopped.

I will now discuss the two points that have been raised as objections against the use of the Lay torpedo: these are the protection afforded to ships by torpedo-nets, and the possibility of cutting its cable.

Torpedo-Nets as a Protection against the Lay Torpedo.

Here I will start with the assumption that ships are now supplied with a torpedo-net which will prevent any locomotive torpedo piercing it, and which maintains its depth at 20 feet and its supports not damaged when the ship using it is proceeding at a speed of 6 knots per hour. This is, I believe, granting everything in favour of ship torpedo-nets.

I assume that such a net would keep out a Whitehead, because if it cannot prevent that torpedo from piercing it, it is of no use against the Lay, which at a speed of 12 miles per hour strikes it a blow of 16,161 foot-pounds, at a distance of 1½ miles, against 10,721 foot-pounds for the Whitehead, going 20 knots per hour, at a distance of 400 yards.

If a ship be protected by nets, the tactics to be adopted by those attacking her with the Lay torpedo would be to send out two of those torpedoes, one following closely behind the other, and possibly directed from different points. The first torpedo, with its enormous charge of 150 lbs. of dynamite, would most assuredly completely destroy the whole net protection and thus open a clear passage for the second

torpedo. If this charge of dynamite does not entirely destroy this net protection, it is of no use employing it to destroy a ship.

The then question naturally arises as to what would be the effect of the explosion of 150 lbs. of dynamite 10 yards distant from a ship and 7 feet below the surface. The answer to this, judging from the experience we possess of such matters is, that very considerable material damage would result to the ship, probably causing her temporary, if not complete, disablement by damaging her machinery or displacing some parts of it.

It has been proposed to provide a net of only a few feet in depth for the special and sole protection of ships against the Lay torpedo, and it is urged by this means that as considerably less surface would be exposed to the resistance of the water, so a greater speed might be maintained, and yet the net kept at its normal depth and its supports not carried away. This is of course merely a matter of conjecture. For my own part I do not believe this difference of 10 feet in the depth of a net would allow any greater speed to be maintained, and with the dropping magazine the Lay net would have to be at least 10 feet deep.

But in the event of a fleet bombarding or blockading a port it cannot be conceived that a sane commander would, on the *supposition* that he was to be attacked by the Lay only, order his ships to protect themselves with the small net, whereby he renders them vulnerable to a Whitehead or spar torpedo attack; and with few exceptions the Whitehead torpedoes, as well as the spar, are universally adopted, either in large or small numbers.

As I have before shown, if this objection as regards nets holds good against the use of the Lay, so much the more is it an argument against the use of any other controllable or uncontrollable locomotive torpedo.

Then when it is considered how at the best a ship's torpedo-net hampers her movements, it may be assumed that in actual practice such defence will be rarely resorted to, and that the protection afforded them against the Lay would be comparatively valueless.

Theory of disabling the Lay Torpedo by cutting its Cable.

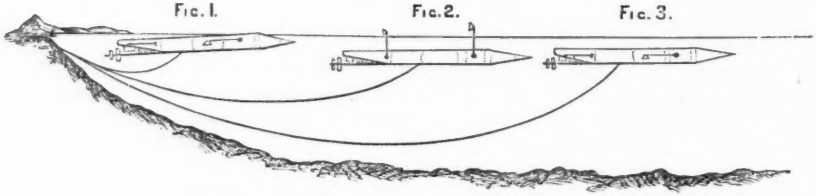
The original idea as to how this was to be performed was this: that a torpedo-boat should at full speed run close to the stern of the torpedo as it was moving ahead, pick up and cut its cable; the supposition being that the Lay torpedo dragged her cable along the *surface* of the water in her wake. Now in actual practice, as I trust I have been successful in explaining to you, the Lay torpedo neither *drags* her cable, nor can the cable remain on or near the surface, as its specific gravity is greater than that of water.

In the trials at Constantinople, where the depth of water was some 40 fathoms, or 240 feet, on picking up the cable some fifteen minutes after the torpedo had commenced to lay it, the cable was most decidedly at the bottom, as proved by its fouling some object lying there.

The cable weighs some 260 lbs. per mile; that is, each 7 yards weighs at least 1 lb. Specific gravity 1·61. As the cable of the Lay torpedo does

not float on or anywhere near the surface, but takes the position shown in Diagram 4, then the method of dragging would have to be adopted, and for any speed to be maintained by the boat with the drag kept at a normal depth of 30 to 40 feet, it would have to be attached to a *fixed* pole, a plan not apparently practicable. It may be doubted whether this method of a fixed drag on a spar will ever be attempted, which must seriously reduce the speed of a torpedo-boat as well as impede its free movements, which are the main attributes of such a craft, and besides offering no practicable chance of success.

DIAGRAM 4.



1. The Lay Torpedo at "rest," with the guide-rods "lowered."

2. The Lay Torpedo when "moving ahead," with the guide-rods "raised."

3. Same as Diagram 2, but with the guide-rods "lowered."

Then, allowing an attempt by a torpedo-boat to drag for the Lay torpedo to be organized, how would it be carried out, and how would it be met by those using the Lay?

The tactics adopted by the enemy would be to dash across the space between the Lay torpedo, when observed, and the point from which it is supposed to be directed. Then, as in the daytime all that could be seen of the Lay torpedo above the surface would be the two guide-discs, and at night-time nothing, unless the torpedo-boat be precisely astern of the Lay, I can assuredly claim that the torpedo-boat would be observed by the Lay operators long before those in the former boat had discerned the torpedo, and so the operators of the torpedo would have the advantage in this respect.

Wherever possible, the Lay torpedo would be accompanied by one or more Nordenfelt anti-torpedo-boat guns, mounted on a field carriage, if it be directed from a point on the shore not fortified, or by a torpedo- or other fast steam-boat, armed with similar guns, or by a combination of a torpedo-boat and field gun. Again, two Lay torpedoes should always be used if possible, each directed from a different point.

Then the Lay operators, observing the enemy's torpedo-boat, if only one torpedo be used, would manœuvre it by using the guide-rods as little as possible and stopping her now and then, so that it would be quite impossible for those in the torpedo-boat to know in which direction she had come or was proceeding.

Or if two Lays are being used, one would be utilized to attack the enemy's torpedo-boat, not actually wasting the torpedo on her, but to

frighten her off by it, while the other torpedo would be quietly proceeding on its way to the attack of the ship.

Or the torpedo-boat of the defence could be sent to attack the enemy's craft.

From what I have said I think it is apparent to practical men that the possibility of disabling a Lay by the cutting of its cable, which does not float but sinks rapidly to the bottom, and in the face of other difficulties may be regarded as quite out of the question with regard to the Lay, but is possibly more feasible in respect to the Brennan torpedo, whose wires are near the surface.

A fog will of course prevent the use of a Lay or any other but a fixed torpedo, and will also equally militate against a blockading or attacking fleet.

As regards a ship being enveloped by the smoke of her guns, if the Lay has been run close to the ship, say 200 to 100 yards from her, before this occurs, it will accomplish the remaining distance without requiring to be seen by the operator.

I will now briefly describe the Nordenfelt submarine boat.

This submarine boat is built of Swedish steel of $\frac{1}{2}$-inch and $\frac{5}{8}$-inch thickness and weighs about 60 tons. On several occasions this boat has been experimented with, and its crew of three men have remained at considerable depths below the surface of the water for long intervals of time without any discomfort. There is no possibility of any danger of this boat when once submerged not being brought to the surface whenever desired, because there are two distinct methods of performing this; one by the aid of the engines, and the other by instantly relieving her of her water-ballast, and allowing the excess of buoyancy thus afforded to the boat to bring her at once to the surface. The Nordenfelt submarine boat can be used in three ways: first, with her turret above water and her funnel up, when she shows about 5 feet above the surface; secondly, when submerged until nothing remains above the surface but her glass dome, 18 inches in height; thirdly, when she is completely submerged at any depth which may be desired.

This boat will be armed with two Lay torpedoes and one rocket torpedo. The tactics to be resorted to with this novel craft are stated in Section III of this paper.

For convenience sake I have divided the tactical question of the Lay torpedo into three sections.

Section I.—*The Lay Locomotive Torpedo considered as a Function of Harbour Torpedo Defence.*

When the complex and numerous duties which must devolve on the navy of a Power possessing any extent of sea-coast are considered, including the actual defence of her military and commercial ports, as well as the ordinary work of a navy, such as the blockading of the enemy's ports, prevention of the same being effected to her ports, the protection of her trade routes, convoy of troops, &c., it may be asserted with truth, "That any navy of the present day is numerically

very weak." And this assertion is further strengthened by the fact of the impossibility of increasing a navy during a time of war, with the necessary promptitude, by building war-ships as powerful as it is now-a-days necessary to construct them.

This almost axiom is applicable more particularly to England, for though her Navy is undoubtedly numerically stronger than that of any other Power, and as a whole more powerful, yet it is not stronger in regard to the number of war-vessels in the same degree proportionate to the immensity of work it would have to execute in the event of her becoming involved in an European war, which would possibly mean a powerful coalition against her.

For, with all her dependencies and colonies, and the vital necessity that exists for maintaining in safety her trade routes, it would be forced on the British Navy to act almost entirely on the offensive.

It must be remembered, that not only must there be constructed a powerful sea-going fleet, coast defence ships, swift cruizers, troop and store ships, gunboats, and torpedo ships and boats, but also an adequate reserve of the same fully equipped, to fill up immediately the gaps caused by the sinking or serious damaging of the ships by the ram, gun, and torpedo.

Further, from the result of the late naval engagement of forts, the deduction may be drawn, that a fleet of powerful ironclads will have immense advantages when engaging shore batteries, even of great strength and power, if the ships possess the right of choosing their own positions, as regards distance and direction, and can move with impunity over the whole ground in the front, and on the flanks of the land-works, by reason of the entire absence of submarine or other torpedo defence.

Then, what I wish to establish by the foregoing statements, is—

1st. That with the numerical weakness inherent in the navies of the present day, it would be impracticable in a time of war to supply ships for the defence of the principal ports, especially in the case of England, France, America, China, and Russia, and at the same time carry on the war in an effective manner.

2nd. That the defence of harbours by fortifications and fixed torpedoes, when deprived of the support of ironclads, is too limited in range, and too passive.

Now there seem to be only two remedies open by which this want in the present methods of harbour defence may be supplied, viz.:—

1st. By increasing numerically the strength of a navy, either by constructing special vessels for this purpose, or by adding to the sea-going fleet, and detailing one or more ships for each important port.

The first part of this remedy, which has been to some small extent attempted, has not commended itself favourably to naval men generally, for many sound and excellent reasons, which it is not the purpose of this paper to discuss. As regards the latter part, when it is remembered how imperative it is to increase the number of sea-going ironclads of any naval Power, it would seem preposterous to construct a number of them which would, during the greater part of a war be locked up, and actually useless.

2nd. By employing the best available locomotive torpedo, either by itself, or in combination with a submarine boat.

Now this remedy seems to supply all the requirements necessary for the auxiliary defence of harbours, by which they shall be rendered self-dependent, that is, independent of the support of ships, thereby, it may be said, increasing the numerical strength of a navy by considerably decreasing the duties it would have to perform.

With every confidence, then, I claim for the Lay locomotive torpedo the power of fulfilling in the highest degree the essential features of a locomotive torpedo for the purposes of harbour defence.

1st. It is absolutely controllable up to any distance that the guide discs can be seen.

2nd. It has a range of 1½ miles (2,640 yards), which may be increased to 2 miles (3,520 yards).

3rd. With the guide-rods down, there is no indication afforded of its position whilst moving ahead.

4th. Its speed is 14 miles per hour, which is maintained for the whole of its run.

5th. It carries a very heavy explosive charge.

6th. It can be anchored, and a break put on its cable to prevent it running out in a current, and this anchor slipped, and break freed at will.

7th. Its extreme portability.

The causes necessitating the features of controllability, and great range, are self-evident; for a torpedo employed in harbour defence must be capable of being manœuvred in tides or currents, and in a sea-way, as well as against vessels under weigh, and therefore constantly altering their position; and must besides possess the greatest range possible, so that the ships attacking the land batteries may be forced to carry out that work at the furthest distance, and also for the protection of all the "dead water," by which I mean that portion of the water in front of a system of fortifications which cannot, by virtue of the contour of the coast-line, be covered by the guns of the forts.

Further, to render the recurrence of the sight witnessed during the late bombardment an utter impossibility, namely, wooden gunboats shelling, and helping materially to silence, a heavily-armed fort at the absurdly close range of 800 to 500 yards.

Though instances have occurred of vessels bombarding a fortified town at the great distance of 9,000 yards, yet if the real object of the attacking force is the destruction of the fortifications, and not merely the throwing of a few shell into the town, or perhaps one here or there into the batteries, the range must be very materially decreased, even, judging from our late experience, to well within 3,000 yards. The average range of the big ships in the late bombardment was, at the outside, 1,800 yards. Then, vessels attacking forts will move at a comparatively slow rate of speed, and therefore 14 miles per hour for the torpedo will be ample; and the greater amount of explosive carried, the greater certainty there is of effecting the complete dis-

abling or destruction of a vessel, no matter at what point the torpedo may strike her.

Again, it may often be advisable to run a couple of torpedoes out from opposite stations, and anchor them mid-stream, so as to be ready to intercept an enemy's vessel attempting in the early morn to rush the entrance, or dash in and disembark a landing party, and for many other purposes.

Further, the feature of portability and the absence of any special apparatus for discharging or starting the Lay on its way, which is one of the most objectionable features of the Brennan, Whitehead, and other locomotive torpedoes, will prove, under certain conditions, decidedly valuable: for by this property the Lay can be easily transported along the shore on a wheeled carriage, or be towed by an ordinary small rowing or steamboat: and thus a blockading force could never be sure from what point an attack with the Lay torpedo might be made.

Lastly, the property of invisibility which the Lay possesses most completely is extremely necessary.

With the Brennan torpedo its single guide-rod is raised at the commencement of its run, and cannot be lowered at will—while the Whitehead's course is marked by a very decided ripple, which would be rendered more distinct in a night-run in phosphorescent water.

So far, I have treated the Lay torpedo as acting by itself, but it may also be carried or towed by the small gunboats carrying one heavy gun, such as the English "Comet," or the Chinese "Alpha," which vessels will enter largely into the defence of estuaries, rivers, &c., or by the specially constructed torpedo-boats.

By means of these gunboats and torpedo-boats, the range of the Lay would be increased indefinitely—that is to say, it would be $1\frac{1}{2}$ miles plus the distance from the shore of the craft carrying it.

In the hazy light of the early morning, or in the dusk of the evening, the gunboat or torpedo-boat, being comparatively a very small object, would stand a very good chance of securing a position distant 1 mile from the attacking force without being discerned, and from that point conduct her Lay torpedo attack with impunity: even in the daytime the torpedo-boats by their rapid movements, and by virtue of their not being forced to remain at any one position when manœuvring a Lay would present but little opportunity at $1\frac{1}{2}$ miles distance to the guns of a ship.

Further, and here the extreme limit of the power of the Lay torpedo is obtained, that weapon will form the armament of the Nordenfelt submarine boat, which, owing to the exceedingly small surface of its dome exposed above water, would be able to take up a position distant 1 mile or less from a ship with the least likelihood of being observed, and thence manœuvre the Lay without having recourse to its submarine properties.

Then, by using the Lay torpedo in combination with gunboats, torpedo-boats, or the Nordenfelt submarine boat, especially in the latter instances, it would, in the face of this offensive defence, be almost impossible to conduct a naval attack on the land defences of a

port or entrance with any probability of success, if the object of such attack be the reduction of the fortifications previous to the capture of the port, or the forcing of the entrance.

This point I may fairly claim without laying myself open to the accusation of having over-exaggerated the value of the Lay torpedo for coast defence when used by itself, or in conjunction with the Nordenfelt submarine boat or the Thornycroft and Yarrow torpedo-boats.

As an illustration of the foregoing I have constructed two charts; Diagram 2 being that of the entrance to the Dardanelles, and Diagram 3 being that of the Port of Cartagena.

In the case of the entrance to the Dardanelles, which at its widest part, viz., from Cape Tekeh to Cape Yeni Shehr, is only some 3 miles, and at its narrowest, viz., from Seddul Bahr to Koum Kaleh, is only $1\frac{1}{2}$ miles across, and where is experienced a current varying from a rate of 2 to 6 miles per hour, is a position most suitable for the employment of the Lay torpedo: the strong current and eddies frequent here would put out of the question the use of any uncontrollable torpedo.

I have chosen five positions at the entrance from which the Lay torpedo could be manœuvred to guard it completely from any attempt made to force it, and also by which the attacking vessels would be obliged to carry on the bombardment of the forts from a distance of $1\frac{1}{2}$ miles, or 2,640 yards, which is beyond the range of fair accuracy of fire.

The full lines A, B, B′, F, and G represent circles whose radii are each 1 mile, and whose centres are the positions similarly marked on the shore; the four dotted lines are portions of circles of $1\frac{1}{2}$ mile radius, described from the four outer points.

The Isle of Tenedos lies only 10 miles S.W. of Koum Kaleh, and Mayro Isle only 4 miles W.S.W., at each of which places batteries would be established supported by the Lay torpedo.

Supposing the immediate entrance of the Dardanelles to have been forced, then the enemy would have to encounter the forts guarding the passage between Chanak and Kilid Bahr, where the strongest currents and eddies are met with, and also the Lay torpedo, which would be manœuvred first from the Kess point and B^2 point, and again from points C and D, only distant 2 miles from the entrance; here, as before, the dotted lines and full lines represent portions of a circle of radius $1\frac{1}{2}$ and 1 mile respectively.

Further, at Cape Nagara, 3 miles above Chanak, where the straits take a great sweep to the eastward, and where the opposite shore is only 1 mile distant, other Lay torpedoes would be used; so also at Cape Peskieri, where the strait is $1\frac{1}{2}$ miles wide, and at Gallipoli, where it is $1\frac{3}{4}$ miles wide.

Then, coming to the consideration of the Port of Cartagena, Diagram 3, though no rapid currents are met with here, yet the configuration of the coast-line offers a position where the Lay torpedo, by reason of its extreme range, would most assuredly increase the ordinary defences. In this case the dotted lines represent the circles

of 1 mile radius, and the full lines those of $1\frac{1}{2}$ miles radius. The positions from which the Lay torpedoes would be manœuvred are Cape Palomas, Point Podadera, St. Anna, Point del Gata, and from the outlying island Escombrera.

For the attack of the fortifications at point B, the nearest position at which the ships could engage outside the limit of the Lay torpedoes (when operated from the shore) would be at X, distant $1\frac{3}{4}$ miles, where they would be in the direct line of concentrated fire from all the shore batteries.

Then there is always the possibility, and not at all an uncommon one, of one or more of the attacking vessels running aground from time to time, which might very likely occur at a point not strongly commanded by the shore batteries, but a ship in such a position must fall an easy prey to the Lay torpedoes of the defence.

I have refrained from citing instances of attack by fleets on fortified harbours and river entrances, which occurred during the American Civil War, and which were usually successful, for though it would have furnished striking illustrations of the value of the Lay torpedo, had such been possessed by the Confederates, because the conditions of naval warfare have so materially altered during the last 20 years; for instance, in these days of costly and huge ironclads, the capture of a port with the loss of three or four such ships could hardly be considered a victory, owing to the extreme difficulty and great time required to replace them, while in the old days of wooden ships, the loss of several of them in a sea fight or bombardment was hardly considered.

I will make only one quotation from Captain Long's, R.N., excellent lecture on the "Study of the Tactics of Naval Blockade;"[1] here, in summing up on the attack made on Charleston by the Federals, he states:—"That the small height of Fort Wagner above the water, and the lowness of the approaches, rendered it the most favourable object for the attack of vessels which could approach within 300 yards at high water, and take it in reverse without being nearer Forts Sumter and Moultrie than 2,300 yards."

This is a practical illustration of one of the numerous weak points that must often exist in a system of land defences, unsupported by some weapon, such as the Lay torpedo, possessing great range.

I will now proceed to Section II.

Section II.—*The Lay Torpedo considered as a Function of Ship Attack and Defence.*

The question of naval tactics has been during the last few years much discussed in this theatre and outside, and also many papers have been written on this abstruse subject, by some of the ablest Officers of our own and foreign navies, in all of which it has been unanimously agreed upon to consider the ram, and the gun, as a ship's only tactical arms. At the same time it is usually stated, as a premise, that a ship is dependent for her weapons of attack and defence on three arms, viz.:

[1] See Journal Royal United Service Institution.

the ram, the gun, and the torpedo—and further that it is imperative that a decision should be made beforehand and strictly adhered to, by the commander of a squadron or captain of a ship, as to which of those arms he intends to treat as his principal weapon, and to arrange his tactics accordingly, the arm chosen being usually the ram, and though the torpedo is spoken of as an auxiliary weapon, yet in all the tactical problems set forth, the positions assigned on paper to the rival vessels are considered only in reference to the opportunities afforded them to ram or to use their guns.

The reasons for thus ignoring the third arm (torpedo) in the study of naval tactics, may be considered to be twofold:—

1st. That the only torpedoes with which ships have been or are now armed, are the towing, the spar, and the Whitehead. The former is a very clever weapon, and would prove no doubt of value in an action on the open sea, under certain circumstances, but it is more particularly a weapon to be used from a special vessel.

The spar torpedo may, under certain exceptional circumstances, be of use as a *ship* weapon, but its tactical value on account of its being a fixture to the ship, and only having a range of 30 feet, is small: ships are now generally supplied with boom or spar torpedoes for the purpose of deterring a ram attack.

The Whitehead, owing to its range being comparatively limited, (only some 500 yards), and also that it requires the vessel using it to be heading properly before it can be discharged with accuracy, does not enable any great practical tactical value to be attached to this arm.

2nd. That with the exception of one occasion (where it failed) ships armed with locomotive torpedoes have not been engaged, and therefore the actual practical knowledge that can be brought to bear in discussing the tactical position of the locomotive torpedo in future naval combats is considerably less than what is to be obtained in reference to the other arms—the ram, and the gun.

Now, by arming ships with the Lay locomotive torpedo, I trust to be able to show naval tacticians that greater deference is due to the locomotive torpedo, considered as a weapon of ship attack and defence, also that in future, when preparing problems on naval tactics or in discussing that subject, the power of this torpedo necessitates more serious attention and importance being paid to it than has hitherto been accorded to that arm. At the same time, I trust it will be understood I have no intention of "rushing in where, it may be said, angels fear to tread," and teach the science of naval tactics, but I merely desire to point out, and invite discussion thereon, certain positions in a naval engagement where the Lay type of locomotive would become an exceedingly valuable factor.

From a perusal of the principal lectures and essays written of late on naval tactics, I venture to assume the following:—

1st. That 2,000 yards may be taken as the extreme effective range for the commencement of an action between modern ships at all equally powerful, the percentage of hits (theoretically) being at this distance only about 20 per cent.

2nd. That ramming tactics will be universally adopted.

3rd. That one side will take the initiative of the attack, forcing the other side to act entirely on the defensive.

4th. That the attack may be considered usually to have the advantage. In stating these four points I pre-suppose the contending vessels to be fairly equal in power.

In Diagram 5 I show two vessels, A and B, both 300 feet in length, at 2,000 yards' distance, the ship B being supposed to be armed with the Lay torpedo; the dark line is the circumference of a circle which has a radius of 1,500 yards, and the dotted one that of a circle with a radius of 1,000 yards. The space within the outer circumference represents the area capable of being defended by B's Lay torpedoes. Taking the speed of this arm to be 12 miles per hour, any point on the outer circumference can be reached by it in 4·3 minutes, and any point on the inner circumference in 2·8 minutes.

The ship A at a speed of 12 knots would reach the outer zone of B's Lay torpedo in 1·2 minutes. The dotted lines branching from A, each 500 yards in length, show roughly the directions that can with any accuracy be given to A's Whitehead torpedoes, supposing A to be able to fire those weapons right ahead and astern, as well as on the beam from upper deck carriages when proceeding at the speed of 12 knots.

The Lay ship or boat torpedo will be only some 18 feet in length, and have only a maximum diameter of 14 inches; it will carry an explosive charge of 100 lbs. of dynamite, and 1,500 yards to 1 mile of cable. Its speed will be at least 14 miles, but in this paper I have only supposed it to be 12 miles per hour.

Diagram 6 represents the tactics supposed to be pursued by the Captain of ship B, armed with the Lay torpedo, in single combat with ship A, armed with the Whitehead; the vessels in other respects being fairly equal, and each steaming at the rate of 12 knots per hour. On sighting one another B would allow A to take up the best position for ramming (which is some two points off B's bow) and initiate the attack; B stopping her engines at 3,000 yards' distance from A, and starting her first torpedo: in 2·8 minutes the torpedo will have reached point T, and the ship A the point A^1: B will then proceed ahead at 12 knots, and in 1·3 minutes will reach point B^1, when the torpedo will strike A at point A^2—B being then 925 yards from A^2. Should some unforeseen cause prevent the first torpedo from hitting A, it will be instantly fired at will, and a second torpedo started: the effect of 100 lbs. of dynamite being suddenly exploded close to A, will most probably cause that vessel's helm to be put hard over, thus offering to the second torpedo a much larger target, when it reaches A, which it will do before that vessel has turned through 90°; also B, under these circumstances, will have the very best opportunities afforded for ramming A, as she will, by turning towards her, obtain what is theoretically considered the position of greatest danger, viz., immediately behind A. During the whole of the engagement, B will present her bow only to A.

Another method of attack may be adopted by B, which is, to send out two torpedoes, the second being started one minute after the first

one, and therefore, remaining 352 yards astern of that one; so that when the leading torpedo has reached A^2, and hit the ship A, or been exploded at will—the other one will, one minute afterwards, strike A.

I have here only exemplified one particular case, the time allotted me for this paper not allowing of my attempting more now; and I can but believe that in future naval wars, single ship actions will most often occur. At the same time, it is not difficult to understand what a strong defence two ships armed with the Lay torpedoes would have, one of which would be sent out 1,000 yards in advance of each vessel, against an attack by two or three ships: the disabling of only one of the attacking force would so seriously disconcert the tactics of that side, as to afford the defenders the most advantageous position. Also in an engagement between two squadrons composed of several ships, supposing the leading vessels of the B squadron to have thrown out each a Lay torpedo, 1,000 yards in advance, and the other squadron to be allowed to take the initiative of the attack, the victory would seem almost a foregone conclusion for the B ships. Again, it might occur in a single ship action that the A ship, having by far the heavier artillery, and by possessing the greater speed, may force B to an encounter, during which at long range a lucky shot from B may so damage A's steering gear or her engines, as to render her helpless; but due to the power of A's guns, B may hesitate from closing her sufficiently to deliver a ram attack or fire her Whiteheads, but B, being able to take up any desired position, 1,000 yards or more from A, could by the aid of her Lay torpedoes have that ship completely in her power. Numerous other instances might be cited of the advantages of the Lay torpedo armament for ships of war in naval engagements, but time unfortunately prevents me from so doing.

I will now take the action between the Peruvian monitor "Huascar," and the Chilian ships the "Blanco Encalada" and the "Almirante Cochrane," for the details of which I have availed myself of Lieutenant Madan's instructive paper on the "Incidents of the War between Chili and Peru," which is published in the Journal, No. CXII.

The object of the Chilian Admiral was to drive the "Huascar" to the north by means of his three slowest ships, and intercept her with his fast ships, which were duly waiting some miles to the north of the coast where the Peruvian monitor was known to be lying off. These tactics proved successful, as at daylight on the morning on the 3rd October, 1879, the Captain of the "Huascar," after being chased all the previous night by the "Blanco" and her consorts, discovered the "Cochrane" and the other Chilian ships off his port bow: Captain Grau at once decided to trust to his (wrongly supposed) superior speed, and escape to the north-east: as it happened the "Cochrane," having been docked and cleaned shortly before this cruize, really was about 1 knot faster than the Huascar.

Diagram 9 shows the position of the two ships at 9·25 A.M., when the action commenced by the "Huascar's" opening fire at 3,200 yards' distance.

The "Cochrane" reserved her fire until she had reached a position

somewhere between A^3 and A^4, distant about 700 yards from the "Huascar." For thirty minutes an artillery duel was maintained between the two vessels, when a shell from the "Cochrane" entered and exploded in the "Huascar's" conning tower, killing Captain Grau and disabling the steering gear, from which time it may be said the capture of the "Huascar" was never in doubt.

Now supposing the "Huascar" to have been armed with the Lay torpedo, and allowing the same tactics to be adopted by the two ships —then having arrived at H^1, distant 1,350 yards from A^1, the "Cochrane's" position at the same time—(the latter steaming at 11 knots, and the "Huascar" at 10 knots), the "Huascar" would start one of her Lays, heading it well in advance of the "Cochrane." About one minute afterwards, the ships being respectively at the points H^2 and A^2, 1,000 yards distant, a second Lay would be started. At A^3, the first torpedo would have hit the "Cochrane," she at that instant being some 760 yards from the "Huascar," and therefore, according to the "Cochrane's" commander, not within effective range of his 9-inch muzzle-loading guns.

The second torpedo, in the event of the first one not effecting sufficient damage, would strike the "Cochrane" at point A^4, some 660 yards from H^4, the "Huascar's" position at that moment.

The escape of the "Huascar" from the Chilian fleet was assured if the "Cochrane" had been destroyed or even crippled.

But if the "Huascar" had been actually armed with Lay torpedoes, and with her superiority of speed over the "Blanco," which vessel when the action commenced was some 4 miles astern, as well as with the well-known desire of the Chilian Admiral to capture her, she would have been steered so as to get within 1,500 yards' range of the "Cochrane" in the quickest time, and then attack the "Cochrane" with her Lay torpedoes, which point would be reached in about three minutes, and the "Cochrane" would have instantly the "Huascar" altered course, also turned to meet her.

The action between the "Shah" and "Amethyst" and the Peruvian monitor "Huascar" may also be quoted in illustration of the value of the Lay torpedo armament for ships.

Here, though the "Shah" was immensely superior in speed to the "Huascar," yet, owing to the great time required to turn her as compared with that vessel, her commander dared not close sufficiently to use the Whitehead, fearing the "Huascar's" ram. But had the "Shah" been armed with Lay torpedoes, she could have run up to within 1,500 yards, started her first torpedo, and then, turning, have enticed the "Huascar" to follow and run on to the torpedo, a second one having been sped in the same direction at a short interval after the first torpedo.

There yet remains to be considered the tactics to be resorted to by two ships, both of which are armed with the Lay torpedoes.

In Diagram 8 I give an example of one phase of this question. A and B having sighted one another at a considerable distance, B so manœuvres as to give A the point of vantage at 2,000 yards' distance; that is to say, allows A to believe that B is the slower of

the two in speed and desires to escape. When A is 2,000 yards astern B starts his first torpedo and proceeds away from A at a speed of 10 knots, starting a second torpedo off at point B^1, half a minute afterwards. Then A, chasing B at the rate of 11 knots, will reach A^1 at the same time as the first torpedo, and when B has reached point B^2, the latter vessel being then some 1,900 yards from A; if A succeeds in evading the first torpedo, the second one will strike her at A^2, about half a minute afterwards.

In concluding this part of my paper, I must express my extreme regret at having been forced to curtail it to such an extent that I have been unable to do little more than generalize on the tactical position of the Lay locomotive torpedo as a ship weapon of the future.

I will now proceed to the last section of this paper.

SECTION III.—*The Lay Torpedo considered as a Function of Torpedo-Boat Attack and Defence.*

A war between some of the principal naval Powers must happen before the proper development of torpedo-boat warfare can be attained (though God forbid that such an opportunity may ever be afforded us!), and therefore, though some faint rays of light may be considered to have been thrown on this part of naval tactics by the Russo-Turkish War of 1877, and the Chilo-Peruvian War of 1879, yet from a practical point of view the rays are too faint to be of much actual value; therefore here, as in Sections I and II, the deductions arrived at must be taken as little better than theoretical.

At the present time torpedo-boats are armed with either the McEvoy duplex spar or the Whitehead fish torpedo, or a combination of the same. Torpedo-boats will be employed either for the offensive defence of harbours or for the destruction of an enemy's ships anchored in their own ports, or carried by ships for auxiliary attack and defence in naval combats on the open sea.

The duty of harbour defence torpedo-boats will be chiefly the constant attack of a blockading force, for the purpose of raising the blockade or for preventing the maintenance of a sufficiently effective, or, as it may be termed, "legal" blockade.

As regards the attack of anchored ships, such opportunities should be conspicuous for their rarity, and in the event of a vessel being forced to anchor in any position open to such an attack, every ordinary and extraordinary means should be taken to render it impossible for hostile torpedo-boats, armed with the Whitehead or spar torpedo, to get within effective range, and a most complete boat-patrol should be instituted.

Rarely indeed will such chances be offered for torpedo-boat attacks as were given to the Russians in their late war with Turkey; for instance, three Turkish ironclads anchored off Sulina, completely unprotected by patrol-boats, booms, or nets; a single ironclad anchored at Soukoum Kaleh, alone protected by boats rowing guard around her; and again several ironclads anchored head and stern in Batoum, guarded by a few boats, and with an advanced barrier of booms and

planks, which means proved ineffectual, as the Russian torpedo-boats evaded the first, and their torpedoes the latter protection. The failure of this and the greater portion of the Russian torpedo-boat attacks were due, not to the means of defence employed by the Turks, but generally to the want of continuity in carrying out the attacks on the part of the Russians, and also to the uncertainty of the Whitehead and towing torpedoes used for the first time in actual war and by men not thoroughly acquainted with their manipulation.

The carrying of torpedo-boats by the larger class of men-of-war is principally for the purpose of attacking disabled ships in an action on the open sea. The idea is that these boats should be lowered before the action, and be towed or follow astern of the ships, from which position they should be prepared to dart out and attack or deter any ship attempting to ram, and also to attack any of the enemy's crippled vessels.

The question that here naturally suggests itself to a practical mind is whether, when required, these ship-torpedo-boats would ever be found to have escaped scot free from the large and small missiles of the enemy's guns.

Having thus briefly sketched the more important work to be performed by torpedo-boats, I will now endeavour to show the value of the Lay torpedo for this service.

The Lay torpedo for boat service would be 18 feet long, and would carry 100 lbs. of dynamite and 1,500 yards to 1 mile of cable with a speed of at least 14 miles per hour.

Each of the first class or sea-going torpedo-boats built expressly for harbour offence or defence would be armed with two Lay torpedoes. The advantages of this form of armament are—

1st. The great distance at which the attack may be made, combined with almost absolute certainty of hitting.

2nd. The perfect freedom of action afforded the torpedo-boat; that is to say, with the Lay armament the torpedo-boat can manœuvre at her highest speed in any direction required. With the Whitehead armament the speed of the torpedo-boat would have to be very considerably reduced, and her head pointed in the proper direction before discharging her torpedo.

3rd. Great simplicity in manipulation, as it is not necessary to know the rate of speed at which the attacked vessel is moving, nor her distance off, nor has any calculation to be made as to the rate and direction of the current, if there be any; all of which has to be done when using the Whitehead, and is exceedingly difficult to estimate at all correctly at night, and any of which may materially affect the chances of a successful shot with that weapon.

4th. The simplification of the construction of torpedo-boats, due to there being no discharging apparatus, either guns or tubes, needed with the Lay.

Take the case of the larger type of torpedo-boat built by Messrs. Thornycroft and Co. and Messrs. Yarrow and Co. These boats are constructed to carry four of the large 15-inch Whiteheads, 19 feet

long, and nearly one-third of the interior space of these boats is taken up by the torpedo-rooms and discharging apparatus and tubes.

Then, in constructing torpedo-boats which are to use the Lay torpedoes, it is only necessary to enable them to hoist up a couple or more of such weapons, utilizing all the space rendered free by the non-requirement of torpedo-rooms, discharging apparatus, tubes, and guns, to more effectively protecting them against machine-guns, and affording them a larger coal capacity; this refers more particularly to the sea-going torpedo-boats.

5th. The great power of the Lay, due to the large charge carried by them.

Then, in making an attack with torpedo-boats armed with the Lay torpedo on a blockading ship, the time chosen would be either the dusk of the evening or just before daybreak. In this case great darkness is not so essential as it would be when using the Whitehead, when the boat must approach comparatively very close to the ship, and also remain there during the time required to fit and discharge her torpedo. The tactics to be observed would be for the boat to advance very carefully to within 1,500 yards of the ship, and then start her Lay torpedo, which would take about three minutes to reach the vessel. At this distance in the dusk or early morning there would be very little chance of the boat being discovered by the enemy, but if that happened she would at once be steamed away from the ship.

All vessels using the Lay would be provided with an extra electric cable, similar to and coiled in precisely the same manner as described for the torpedo cable, so that by connecting these cables up, the vessel might move at any speed in any direction without dragging out the cable in the torpedo, or otherwise interfering with her manœuvring.

Though the electric light brought to bear on the torpedo-boat at that distance might possibly discover her, yet her variable and considerable distance, also constant changes of direction, would offer little chance to the ship's guns, at the same time the electric light would show up the ship more distinctly to those in the boat.

It must be borne in mind that the Lay torpedo keeps a very direct course when uninfluenced by strong currents for a considerable distance; neither sea nor wind causes it to be deflected.

If the vessel is known to be protected by nets, then both torpedoes would be sent out, one following closely behind the other.

Another plan of attack, which seems to me to possess great chances of success, is for the fast torpedo-boat to tow out a small rowing-boat, and when within 1,500 yards distance from the ship, drop the boat and torpedo, which would be operated from the rowing-boat; the torpedo-boat at once steaming away from the ship, and well clear of the operating boat; then if the electric light search out the torpedo-boat, she would so manœuvre as to keep the beam of light on her, and if possible draw the ship after her; the operator in the small boat utilizing the electric light for directing the torpedo to the ship.

There are numerous other methods of torpedo-boat tactics, but the foregoing suffice to illustrate the advantage of the Lay armament for such craft.

I will now cite two actual instances of attacks made on ships at anchor by torpedo-boats, in both of which cases, had the Lay torpedo been the weapon employed, a success instead of a failure in each instance would most assuredly have been recorded.

At Batoum, on the night of the 28th December, 1877, four Russian torpedo-boats attacked a squadron of Turkish men-of-war anchored head and stern. The night being exceedingly dark two of the attacking boats succeeded in evading the few Turkish guard-boats patrolling the harbour, and at a distance, differently estimated at from 150 to 60 yards, discharged two of their Whiteheads against a Turkish ironclad, both of which failed in their object, but were the next morning discovered high and dry on the beach, just astern of that vessel.

This latter fact proves the absence of any serious barriers in advance of the vessels, and therefore a Lay torpedo would have had a clear course.

Supposing the two Russian boats to have been armed each with two Lays, then instead of getting so close to the Turkish ships they could have remained at say some 800 yards from them, and thence, each boat having picked out a ship, started their Lays, two for each vessel, one closely following the other, so that whatever surface obstacles may have been in the way the leading torpedoes would have destroyed them, and the ones following have dashed on, and each hit and severely damaged, if not sunk its ship.

Allowing the barrier to have been placed 220 yards in advance of the ships, then the first torpedoes would have destroyed it in about eighty seconds, and the second ones started half a minute after would hit each its ship in one minute from the time of the explosion. There was a slight swell experienced on this occasion which, combined with the darkness whereby the distance could not be at all correctly estimated, and which prevented the delicate adjustments of the Whitehead being properly applied, as well as the apparatus for launching these Whiteheads not being very perfect, may be adduced as the principal causes of the failure of the attack. Further, the fact of being within 200 yards of an enemy's fleet, and in an unknown harbour, may have somewhat disturbed the highly strung nerves of those making these adjustments.

Now, with the Lay neither the swell nor the darkness, so long as the ship could be seen, would have affected its manipulation, and the knowledge of their comparatively great distance from the enemy, as well as the simple and ordinary nature of the work being executed, would always tend to allay instead of to increase any excitement of the operators.

The second instance occurred during the Chilo-Peruvian War of 1879–80. At 4 A.M. on April 10, 1880, the Chilian torpedo-boat "Guacolda," armed with two spar torpedoes on the McEvoy system, entered the harbour of Callao, and succeeded in exploding one of

her torpedoes under some booms fixed at a distance of about 15 yards from the side of the Peruvian corvette "Union," before her crew, armed and on the watch, could fire a shot. The "Guacolda" escaped without receiving any harm, and the "Union" experienced only a severe shaking.

Now, had the "Guacolda" been armed with two Lays, she might have remained at the furthest distance at which the Peruvian ships "Union" and "Atahualpa" could be distinguished, and then from there with the greatest ease and certainty have destroyed them both; the half circle of spars protecting the ships would not have stopped or fired the Lays, as, owing to the conical shape of their bows, and the submergence of their noses, they would have slipped underneath them, pushing down the guide rods only to be raised again when clear.

I have taken the foregoing incident from Lieutenant Madan's paper, and in which he makes mention of there being several foreign men-of-war in Callao harbour at the time of this attack; and, moreover, he states that the "Guacolda" nearly collided with one of them. Trusting I shall be excused for diverging from the subject of this paper, I would ask what would be the result of the destruction of a foreign man-of-war by mistake when at anchor in an enemy's harbour during a night attack, such as I have just described? It is well understood that the success of a torpedo-boat attack is mainly dependent on the secrecy with which it is organized and carried out, and therefore no warning could be expected to be afforded non-belligerents that such an affair was about to happen, and also the possibility of mistaking one man-of-war for another on a dark night is extremely likely to occur.

Time here also unfortunately prevents me from discussing other known torpedo-boat attacks which have occurred in actual war, and from showing how the failures which generally resulted from them would have been successful had the boats been armed with Lay torpedoes.

And here comes the consideration of the tactics to be adopted when making an attack with the Nordenfelt submarine boat. As I have previously stated this craft will be armed with two small Lay torpedoes and one rocket torpedo. When moving out to the attack it is intended for the boat to remain with her turret above the surface and her funnel up. On reaching a distance of 2 to $1\frac{1}{2}$ miles from the attacked vessel, her funnel will be taken in and the boat submerged until only her glass dome remains above the surface; when distant from the enemy about 1,500 to 1,000 yards, she will stop and start one of her Lays. Should this fail she will then be taken closer (800 yards distant), and thence start her other Lay; if this be unsuccessful, or if the boat be discovered from the ship, she will then be completely submerged, close to 100 yards, and then fire her rocket torpedo.

Another most important use of this locomotive torpedo would be as the armament of specially built torpedo-ships, which are intended to attack the heaviest armed ship at very close ranges, and rely solely

on their torpedoes and ram for their powers of attack and defence. The advantages of arming such a vessel with torpedoes which can be manœuvred at long ranges with absolute certainty, and which require no special fittings, are self-evident.

I have in this paper attempted to point out certain positions in which the employment of the Lay locomotive torpedoes would prove a most valuable factor of attack and defence, whether used from a ship in engagements on the open sea, or in torpedo-boat attack, or, further, as a weapon for the defence of harbours, rivers, estuaries, and channels, and trust I have succeeded in proving the value of this weapon to such a degree as to show that it is worth a practical trial.

Appendix.

In Diagram 9 is shown a sketch of the day trial of the Lay torpedo at Constantinople in November, 1882.

The velocity of the current was 3 miles per hour in the direction shown by the arrows.

The force of the wind (southerly) was 5. The distance between the tug boat (A) and target boats (B) was 3,648 feet, or 1,216 yards. The space between the target boats was about 90 feet.

The whole length of the run of the Lay torpedo, from the tug boat through the target boats and back to T′, was 6,096 feet, or 2,032 yards. The amount of cable coiled in the torpedo was 2,420 yards, or 7,260 feet. Therefore, waste of cable, due to current and depth of water, was about 264 feet. The depth of water was 40 to 50 fathoms. The duration of the run was 11 minutes. The amount of gas in the torpedo reservoir was 260 lbs., and the amount expended was about 115 lbs.

In the night trial, made a few days afterwards, the torpedo was run the same course through the target boats, but was not brought back, as its lamps are not intended to be seen from ahead. The current on this occasion ran at the rate of at least 6 miles per hour, and there was no wind.

The torpedo cable was on each occasion made fast only to the keyboard, which weighs 5 lbs., and was not in any way secured.

Vice-Admiral Gore Jones, C.B.: With your permission, Sir, I should like to make a few remarks upon the paper to which we have just listened. During the six years that I was Naval Attaché in America, I saw the Lay torpedo experimented with fully a dozen times, and in the whole of that time I never saw a successful run. The lecturer has laid great stress on the intricacy of other torpedoes, but I think the Lay torpedo is just as intricate as any other that we know of. There are, I think, some radical defects in the Lay torpedo; one is in the power with which it is driven, viz., carbonic acid gas. In the first place carbonic acid gas starts the torpedo with great velocity, but it very soon decreases as the reservoirs empty. In the second place, carbonic acid gas is subject to the effects of temperature, and I was told, in one of the experiments, that a heated shot was put in the chamber where the gas receivers were, to keep the carbonic acid gas up to its temperature.[1] In the early experiments the cable was always kinking. At first it was reeled up, and then it was faked down, as sailors say, like the top-sail halyards; but, nevertheless, the kinking occurred and ended the experiment. In the next place, there is a good deal of danger connected with the explosive quality of carbonic acid gas, and at Rhode Island, at the torpedo station, on one occasion one of the flasks containing the gas

[1] The carbonic acid gas is put into the receivers at high pressure in a liquid form, and the expansion of the gas is very sensitive to temperature—being torpid in very cold weather and the reverse in warm. A small heated V pot therefore, placed in the compartment where receivers are, would increase expansion.

burst and knocked everything to pieces; and then, how is carbonic acid gas to be manufactured on board a ship for fleet service? It is an impossibility! Then, again, we come to the towing of the cable and velocity. I deny entirely the speed. I never saw a Lay torpedo used the whole time I was in America that went 7 knots, let alone 14, but Colonel Lay may have improved his speed in the last three years. With regard to the cable running along the ground, that I deny also. There is a very large bight left, and any fast boat with a grapnel passing across it would certainly grapple and disable it. But this is a matter of small consequence, because, if these things are to be used, the ships to be attacked are something like birds, and would not wait to have salt put on their tails, but if done when nobody is dreaming of an attack, I admit the feasibility of it, and it is much the same with all torpedoes; but when you take the case of two ships manœuvring, how in the world could a torpedo be sent out with a great bight of cable when both ships are going at any speed? It is an impossibility to send out a boat towing a long line astern to go into action against a movable enemy from a moving base. The torpedo-boat would become unmanageable and could not be directed, and I do not think any Lay torpedo was ever run where the basis of the operation was not steady. In one of the reports that I made, the first time I saw the torpedo, I said it manœuvred like a sea snake: but when we came to look at all the disadvantages of it afterwards, I came to the conclusion that it was not an effective weapon of war. There are places, such as the lecturer has referred to, where in narrow passages unquestionably it might be sent out, and might be effective; but only in those positions. I look upon the motive agency as a very great danger, because it might explode at any time through change of temperature, and to have such reservoirs in a ship would be highly dangerous. Then, again, you would require the ship to be constantly manufacturing a very dangerous chemical. It may be answered that you can use compressed air, as is done in the Whitehead torpedo, but still it has not been done up to the present time and would much shorten the effective range. I have seen a torpedo sent out at night, and very fairly guided, but then it was sent from a fixed position in a known direction, and the whole thing might be done by compass bearings. That could never be so in actual war; therefore, I think a great deal more will have to be shown to make the torpedo a vessel that is at all likely to be useful in the general service afloat; but it might possibly be effective, provided only the attacking force was not aware there was any Lay torpedo likely to be sent out against it.

Captain DOTY: I have given this subject of moving torpedoes some attention for the last twenty years, having been one of the first to bring it to the notice of this Government. I have listened to the remarks of the distinguished Admiral on the other side, and I gather from what he has said, that the Lay torpedo must be worked solely from a fixed base. Taking into consideration the remarks made with reference to the torpedo-boat, I understand that the Nordenfelt boat is unlike anything that has hitherto been produced. It is a boat capable of being submerged and stopped at will. It may be run out into a bay and there stopped, and the torpedo, which is fastened alongside, may be detached and sent on its mission while the submarine boat remains as a base of operations. I conceive this to be a very valuable auxiliary for the defence of harbours and roadsteads. I have seen the Lay torpedo in America. I was on board the "Alarm" when it was experimented with; I have noted some of the improvements that have been made, and after the recent experiments made at Constantinople, I feel justified in making a bold prediction and prophesying that the Lay torpedo will yet be the leading arm of defence for the protection of harbours and roadsteads in conjunction with the submarine boat from which it is proposed to work it.

Captain MACLEAR, R.N.: There are many other Officers present who have studied this subject far more than I have, and I only ask for information on one or two points. The advantages claimed for this torpedo make it a most formidable weapon; but one point that struck me during the reading, was whether this was a real torpedo, or merely a theoretical one; because one would like to know more about the details. I have not quite understood whether its cable is carried out in the torpedo and paid out as it goes along, or whether it is paid out from the ship or discharging point. If the latter is the case, I have no hesitation in saying that no

boat, of whatever speed, can manœuvre whilst towing a cable. The extra cable that has been spoken of to be supplied on certain occasions would, I take it, have to be towed, and that, as Admiral Jones has said, would render the torpedo perfectly useless.

Lieutenant SLEEMAN: There is no towing at all. Whether the ship is moving, or the torpedo moving, a child three years old can hold the cable in his hand; there is no drag whatever.

Captain MACLEAR: I should like to know how the supply of carbonic acid gas is to be carried, and whether the torpedo is to be kept charged with it, in fact, where the torpedo is to be charged, and how? Also, what would be the effect of a shot striking the carbonic acid gas chamber, because if it is only made of $\frac{1}{8}$-inch iron it is penetrable to rifle shot.[1]

Mr. QUICK, R.N.: The objections to the Lay torpedo have been so well stated, that I will not go into the question, further than to say that it appears to me that, like everything else, it has its valuable side and its useless side. I do not see my way at all to its use in deep-sea fighting, though it is possible it may be useful for harbour defence. The great objection to this torpedo is want of speed, that the propelling power would soon be exhausted, and consequently would not carry the torpedo the distance necessary in cases where both ships are moving at a considerable speed. It has been said that there would be no drag on the cable. Now I am quite prepared to admit that there would be no drag when the ship from which the torpedo is discharged is stationary; but I do not think it is possible for the ship to be moving, from which the torpedo cable is paid out, and yet to have no drag on the cable and key-board. It seems to me utterly impossible. We all know how much strain there is upon log lines towed from a ship's stern, and, however you make the cable, if your torpedo discharging-ship does not move directly opposite the Lay torpedo, you will have a most tremendous strain. In the other case where the torpedo-ship is quite stationary there is no strain at all; so that although as regards fleet actions or deep-sea fighting the Lay torpedo is altogether out of the question, it has very valuable qualities for harbour protection. The point I would wish to urge is the great speed that should be possessed by all locomotive torpedoes. We talk of ramming. Ramming, of course, is a very fine thing; but if you have a torpedo which you can discharge from your bow at a speed of say 30 or 50 or 100 knots an hour, what, then, is the use of ramming? I cannot see it. But it is said that it is impossible to have this enormous speed. Twenty years ago, the idea of having torpedoes to go 15 or 16 knots seemed almost absurd; but the absurd of to-day is the possible of to-morrow. We all know now that torpedo-boats can go 20 knots. The Whitehead torpedo has gone 29 knots, but had we said that twenty years ago, we should have been laughed at. I believe myself it is quite possible for the speed to be very largely increased—when I say very largely, I mean to say that by means of rocket composition you will get at once the greatest power possible. When you want an immense power in a small compass, you must fall back upon rocket composition. It is an old idea, but it has never been properly worked out. I hope and believe that it eventually will be. There are people in Russia, in Germany, and, I believe, in this country, who are working at this point, and it is in the development of that idea that you have the future torpedo for deep-sea fighting, fleet against fleet, and ship against ship. But you also have another thing. I see very clearly that you will have to have flying torpedoes, in the shape of torpedo shells carrying an enormous explosive charge through the air. I do not come here to discuss my own inventions in this matter, but only to point out the possible future and the limitation of the Lay torpedo for deep-sea fighting. The present explosive charge of the Lay torpedo is said to be small; but small as it is, it is quite sufficient for its purpose if you strike the ship in a vital part. I say again that

[1] A great deal of experience in sounding at all depths, from ships and boats, with varieties of lines, has taught me that the resistance of water is very great even to bass pianoforte wire; and that to medium line which would be about the size of insulated wire, water acts almost as a solid the moment the line is drawn aside out of the straight course. The diagram only represents the position of the line if the boat remained stationary, the curve would be very different were the boat in motion.

the fighting torpedo for fleet actions, ship against ship, must be looked for in the rocket torpedo, as has been mentioned by the lecturer; for I know that the range can be increased very largely, and a speed attained of more than 100 knots an hour, and high speed ensures accuracy.[1]

Mr. NORDENFELT: The lecturer has mentioned the submarine boat that I am building. This, however, is certainly not the time to speak about it, except to say that for anything like a boat which attempts to go down in the deep water, a Lay torpedo seems to be exceedingly useful, because I require no machinery for ejecting it. Admiral Jones saw the Lay torpedo in America when it was a baby. Now I dare say that our President has more experience than most of us as to guns and other things, which, when they first come to light, are full of childish illnesses, but afterwards turn out to be useful. I fancy it is the same thing with this torpedo. The figures given are against Admiral Jones, because he supposes that you cannot succeed in going anything like 14 knots. The Russian torpedo-boats are very near this, as they have gone over 12¾ knots. The torpedo may therefore be considered very nearly full-grown. There is one point to which it is especially important to draw attention, namely, the question of loss of wire. Now I do not know anything about fleet actions; but if the torpedo is used for port or coast defence—say for instance at the Bosphorus—as long as the water is shallow, the wire of this small calibre must necessarily sink rapidly to the bottom. As a matter of fact, at Constantinople when the wire was picked up it had fouled at the bottom. Anyhow, the wire being held at one end, in the first instance by the shore end, and afterwards by the friction of the bottom of the sea, and having no strain on it where it is paid out of the torpedo itself, there is not the slightest doubt but that it must sink very quickly with its specific gravity of 1·6. The loss of wire is consequently only slightly more than the actual depth of water at Constantinople, this loss was barely 200 yards, and considering the great depth of the Bosphorus, there is not the slightest doubt that you would lose very little elsewhere.

If the wire goes down to the bottom, I presume you cannot grapple on the bottom; therefore in shallow water the enemy could not take it up. If his torpedo-boat were to run very close to the torpedo, and try to keep up with her, it would have to run up very quickly, considering that it would have to come from a certain distance. The enemy's boat would have to put the spar down for grappling, and could not steer with anything like a spar held down into the water. If the Lay torpedo were discharged from the torpedo-boat, the enemy's torpedo-boat would have to show a broadside towards the torpedo-boat which discharged the Lay, and I doubt whether any torpedo-boat, at such a short range, would like to face machine-guns firing at her broadside from my own torpedo-boat. I do not believe that the enemy's torpedo-boat would try to pick up the Lay torpedo, knowing that the operator could at will discharge it at any given moment. If a ship came up the Thames to Woolwich, or down the Bosphorus, and had torpedo-boats with her, then the operator, seeing the torpedo-boats of the ship coming down, would send his torpedo with the guide-rods down, only turning them up now and then to see where it was, until it had reached the point where he expected the ship to pass, and no grapple could possibly then be effective to prevent the torpedo running in. Furthermore, if the wire were grappled—the worst thing that could happen—it would not stop the torpedo in any way; the only result would be that the controllable Lay torpedo would become an

[1] As to the possibility of attaining a very high speed by means of rocket composition it may be mentioned that a 24-inch rocket torpedo can be constructed to exert a propelling energy for eighteen seconds equal to 3,100 I.H.P. The propelling energy of a 15-inch rocket torpedo would be about 1,360 I.H.P.; and that of the 12-inch rocket torpedo would be 760 I.H.P. The propelling energy of the old pattern 16-inch Whitehead torpedo was only about 3¼ I.H.P. and speed 8 knots; that of the newer pattern 14-inch Whitehead torpedo is from 9½ I.H.P. to 18½ I.H.P., giving a speed of 19 to 25 knots. That the probable speed of a properly constructed rocket torpedo will be very great is therefore evident. But it is to be borne in mind, that the efficiency of the rocket composition for propelling purposes depends entirely upon the method of its treatment, and in the minute detail of its arrangement.

uncontrolled torpedo, like those of other systems, and would continue running its course, though without further guidance from the operator; therefore, if it can get within a couple of hundred yards of a ship before it can be grappled, it still would retain the same chance of hitting as any other torpedo would have at that distance. It would, perhaps, be right for me to state that, probably, neither my guns, nor any other machine-guns, can fire with effect against a torpedo running 10 inches below the surface of the water, nor can we hit any other torpedo submerged. The object of the guns is more to fire against the boat from whence the torpedo is discharged, and the Lay torpedo will, on this point, offer this advantage, that it could be started at a greater range than others, and the calibres of machine-guns might have to be increased for firing at such long distances.

Captain CROZIER, R.N.: I have been advocating, for some time, the principle of having fore and aft bulkheads and watertight compartments; so that if the torpedo struck one part of the ship, the ship would be kept afloat by those bulkheads. My idea is to have an iron bulkhead from stem to stern, combined with watertight compartments, so that although one part of the ship may be injured, still the other would not sink. I think if that principle was adopted in our merchant service, many ships would be saved.

Captain MCEVOY: I regret that we have no record of any very important experiments that have been made to demonstrate how far nettings are really a protection to ships. It strikes me that the explosion of a charge of 150 lbs. of guncotton or dynamite against the nets of a ship which was under weigh, for instance, would destroy the whole fabric of the netting and booms, and everything on that side of the ship, and there would be no protection against other torpedoes that might follow immediately after; not only that, but the dangling fragments of the disruptured netting would be swept astern and in all probability foul the screw. I do not think it is probable that a vessel would carry two sorts of netting, one against torpedoes, running near the surface, a shallow netting; and the other, a deep netting, for the reason, that when they had out the shallow netting as a defence against the Lay torpedo, they might be attacked by deep running torpedoes, and, consequently, it would be absurd to suppose that they would carry two sorts of netting, not knowing which to use. The principle of the Lay torpedo has always been a fascinating one to most men interested in torpedoes, and I think it is regarded as a very important one. I know that the early record of the Lay torpedo is not a very good one; but yet, the same may be said of nearly all inventions. We can scarcely find anybody at present who will acknowledge that he was ever opposed to breech-loading firearms, and yet we know that they were kept out of the Service for years after they had reached a very considerable degree of perfection. The Lay torpedo, from what I know of the improvements in progress, has, I venture to say, a future which will be quite the reverse of the past, and I think a little time will demonstrate that fact.

Captain CURTIS, R.N.: I came to the Institute this afternoon with the idea of finding fault with the cable, but Lieutenant Sleeman seemed to say that it paid out so rapidly off the reel that it sank at an angle of 45°, and of course, in that case, there would be some difficulty in grappling it. I think, however, that a torpedo weighing 1½ tons is no baby to handle quickly in a boat. One of the great features to be admired in it, is the relative specific gravity of the torpedo, keeping it within a certain distance of the surface. I think, however, there has been some error with respect to ships forcing a passage, and that under such circumstances, the ships will go two or three abreast with a swarm of torpedo-boats and Nordenfelt gun-boats covering them. Now I should not like to do Mr. Nordenfelt the injustice of saying that his gun would not penetrate one of these torpedoes under water; for I think the result would be that in all probability the torpedo would lose her specific gravity and go to the bottom. Probably with the very good look-out which they will have in some of these new ships where they have 8 or 9 Nordenfelt guns on the broadside, if the men cannot see these guiding rods they ought to be ashamed of themselves, and I should do Mr. Nordenfelt's gun considerable injustice if I thought that it would not sink one of those Lay torpedoes only immersed 9 inches. I believe his guns are intended to penetrate and sink torpedo-boats; therefore, after all, the great feature in the Lay torpedo is to establish what we commonly

call a "funk;" that is to say, they will be used in narrow passages, and there, no doubt, your practice ought to depend upon the moral courage of the Officers of the fleet, or the Captains of the ships attacking a port.[1] Carbonic acid gas is a very dangerous thing, and, as Admiral Jones says, I should not like to have the trouble of manufacturing it on board ship. I have, therefore, come to the conclusion that this torpedo is not adapted for use in the deep sea, but that it is adapted for narrow passages more to create a fright than for anything else.

Captain F. HARVEY, R.N.: I should like to say one or two words about the Lay torpedo. I happened to be in Peru at the time of the late war, and perhaps, having been on the spot, I could give you a direct account as to what took place with the "Huascar." The "Huascar" had a Lay torpedo on board before the last action, and it was entirely through the mismanagement of the person in charge that the torpedo did not prove of service in that action. The torpedo was in command of Colonel Chester, who was not considered by Colonel Lay to be skilled in the management of the torpedo, otherwise, I think it would have proved a success out there, and would have saved Colonel Lay a good deal of trouble now.

Captain MARKHAM, R.N.: It is not my intention either to criticize or discuss the merits or demerits of any of the motive torpedoes which have been alluded to by the lecturer to-day. I simply wish to say a few words with reference to what the last speaker has said. The lecturer implies, if he has not absolutely asserted, that had the "Huascar" been provided with the Lay torpedo when she was fighting the "Cochrane," a different result to the action would have been recorded. The last speaker has informed us that the "Huascar" was, prior to the action, provided with the Lay torpedo, and I would wish to state that there was also a duly accredited agent of Colonel Lay's specially sent on board that ship to manipulate the apparatus, and also for the purpose of instructing others in its use. This Lay torpedo was used in the roads of Autofagasta on the coast of Bolivia, when Captain Grau attempted with it to destroy the Chilian corvette "Abtao" lying at anchor in the bay. On the discharge of the torpedo, however, it is reported to have turned straight round, and to have come directly towards the ship from which it was fired, thereby imperilling the safety of the "Huascar." The danger was only averted by one of the Lieutenants pluckily plunging overboard and deflecting it from its course. This failure was the real reason why the "Huascar" was unprovided with the Lay torpedo when she fought the "Cochrane." The only motive torpedoes the Peruvian Government possessed, of which we have any knowledge, were the Lay. There was undoubtedly a motive torpedo, and presumably a Lay sent out for the purpose of destroying one of the Chilian blockading ships off Callao, but, either through some insufficiency of wire, or derangement of the adjustments, it exploded, or was exploded before it reached within a third of a mile of the ship that it was destined to strike. I know the Peruvians had several Lay torpedoes in their possession, but for all the use they were, they might just as well have remained in the United States. There is one other point I would like to refer to. The lecturer has said "that although the 'Shah' was immensely superior in speed to the 'Huascar' when she fought her memorable action with that ship, yet, owing to the great time required to turn her as compared with a short vessel, her commander dared not close sufficiently to use the Whitehead." Now, as a matter of fact, the Whitehead *was* used, but, it must be remembered that it was one of the early pattern Whiteheads only possessing a speed of about 8 or 9 knots. The "Huascar" had therefore very little difficulty in avoiding it.

Lieutenant FASCE: The last speaker has only corroborated what I said as to the Lay torpedo being mismanaged on the "Huascar" before the action. If they had succeeded in managing the torpedo at that time, there is no doubt that the "Huascar" would have had the Lay torpedo to use throughout the remainder of the war, because Captain Grau intended to have it.

The CHAIRMAN: We have had a very interesting lecture and a very good discussion, and, seeing that the time is so far advanced, I shall offer very few remarks. In the first place, the lecturer has not mentioned one torpedo of recent

[1] I believe there are many ways of diverting and arresting torpedoes in their course, independent of the ship's netting.

invention, that is the Berdan; perhaps he can tell us something about it. I have heard it mentioned as a very promising one; one remarkable circumstance is the slight progress that has been made of late years in the manufacture of torpedoes. It is ten or twelve years since the Whitehead came to the front, and the original ones are still under certain conditions very good weapons. It is not worth while for mechanicians and scientific men to waste their time and money in experimenting on an implement that is scarcely of marketable value. That is one reason why torpedoes have not been developed more than they have been up to the present time. I am pretty well acquainted with the Whitehead, but I confess as to the Lay, I know nothing about it. As a sea torpedo to work from a moving base, I do not see that it can be applied practically. I do not see how it is possible, with one ship going one way and another another, that a torpedo is to be steered by the first ship so as to strike the other ship, the vessel actually steering it going on a different course. I have had some little experience in steering boats electrically, both in the day time and at night, and I found there was great difficulty in steering the boat after she had gone a certain distance. The only time when she could be steered with certainty was when the observer was directly astern. I have no doubt the steering apparatus is very greatly improved since then, but at the same time, I do not think you can steer accurately beyond a very few hundred yards. You can only steer a thing as long as you can see it, and to put up two pickets, or to put two lamps very close to each other, and to manipulate the steering by them at any distance, appears to me to be quite impracticable. I can see a use for the Lay in narrow waters from shore, or from a fixed base; but I cannot imagine its being used successfully from a moving base, or being regulated and controlled when the ship from which it starts is herself manœuvring. One or two statements have been made about the Whitehead, in which I do not think the lecturer has given that torpedo quite sufficient credit. He said the highest speed attained was 26 knots. Mr. Quick said 29. I had never heard of that, but I knew that it had attained a speed of 27 knots, and I have no doubt the speed of the Lay may have increased in the same proportion since the earlier trials. The lecturer says, "Practice with this torpedo by men who are not experienced would not be attempted on a vessel going at a greater speed that 10 knots." Now from my knowledge, I think that no one except experts could possibly hope to succeed with any description of torpedo, not only the Lay, but any other. A friend of mine, well acquainted with torpedo work, a short time ago made the observation with reference to the Whitehead, which I do not think is more complicated than the Lay, that to make it a success you must "love it;" that is, you must be always working at it. You must understand it inside and outside. It is like a mother and her child; practice once in three months will not do. No one but experts, by which I mean persons specially trained, must ever be put to carry out torpedo work. I will not detain you further, but will ask the gallant lecturer to reply to the questions that have been put.

Lieutenant SLEEMAN: In answer to the attack that has been made on the Lay, I would first like to ask Admiral Gore Jones as to the date when he saw these trials.

Admiral GORE JONES: I saw the trials on several occasions under the most favourable circumstances for about six years. I went to America in 1873, and left in 1879. I saw a dozen trials under the most favourable circumstances with the inventor there. I went long distances to see them, and always had to return home without having seen anything really effective.

Lieutenant SLEEMAN: In answer to Admiral Gore Jones I can only say that the Lay torpedo has been much improved during the last few years, for he states that the earlier trials were generally unsuccessful, whilst from 1878 the Lay trials have been attended with uniform success. I have personally seen it run as I have described here, and it was most successful; and I do not think any doubt can possibly be thrown upon my word, one who has had a great deal to do with electrical apparatus of every nature. I must say I have never seen, and I do not believe it would be possible to imagine, anything more simple than the electrical mechanism by which the torpedo is controlled. As regards the speed of 14 miles, I never intended to say that the Lay had a speed of 14 miles. Colonel Lay is a gentleman who does not like to say what *can* be done, but only what *has* been done. I have seen the Russian official reports of the trials in 1879, 1880, and 1881, of the trials with ten

of his torpedoes, built by Colonel Lay in Russia, one of which ran three-quarters of a mile out, and three-quarters home in 7 minutes 58 seconds, which is at the rate of 12½ miles per hour. That is a fact, which, no doubt, the Russian Attaché will vouch for; I have, therefore, in my lecture, taken the speed of the Lay as 12 miles per hour. The speed of the one that ran at Constantinople was only 8 miles, as I said, the one that is now building, I expect you will find has a much greater speed than you seem to anticipate. Admiral Gore Jones seems to imply that the cable will sink; I do not see how anybody could say that, after my stating from personal experience that the Lay cable, in 50 or 60 fathoms of water, was on the bottom and broke there, causing us to lose a portion of it, in our day trial at Constantinople; therefore, there can be no doubt about the cable sinking. As regards the danger attendant on using carbonic acid gas, I remember, not long ago, a very serious accident happening at Portsmouth during the compression of air for a Whitehead; still the Whitehead is being used. Our new breech-loading gun burst the other day, but I believe we are still using breech-loading guns; boilers have burst very often, but still there are steam-boats. My experience of the manufacture of carbonic acid gas enables me to declare its freedom from danger, and its exceeding simplicity of manufacture. It has never been intended, however, to make this gas on board ship. Each torpedo would be supplied with two, three, or four spare filled reservoirs. As regards the storage of the gas, a reservoir was discharged at Constantinople which had been partially filled three or four years, and the gas was in perfect condition. The gas is only put into the reservoir at a pressure of 800 to 900 lbs. and the reservoirs are tested to 1,600 lbs.; therefore, I think, as far as the gas is concerned, there need be no mistrust. I have tried to explain about the cable as clearly as possible, but it seems to puzzle everybody. Hobart Pasha would not believe that there was no drag on the Lay cable until he saw it himself. He is a difficult man to convince, but he *was* convinced after witnessing the trial that the cable offered no drag whatever. It is reeled on a reel, and when the reel is full a thin iron jacket is placed over it, and the core of the reel is removed, leaving a cylindrical coil of the cable. There is not the slightest possibility of a kink in that cable, as Colonel Lay does not use the reel now. In his old torpedoes he reeled it and unreeled it as he went ahead, but he now takes the reel away and leaves the core. In Belgium he ran this torpedo twice, in Russia once, and ten other new ones; in Constantinople he has run it twice in my presence, and in China twice, and on no occasion has there been any kinking of the wire. Captain Markham says an expert was sent out with the Peruvian Lay torpedoes; I should like to ask whether it is likely that a foreign Officer, who might be considered an expert, would be got to go and fight for a foreign country against another country that he did not care a rap about? *We* know perfectly well that the gentleman who went out there was not an expert. The torpedo was on one occasion tried, and it was supposed to have turned back. It is very easy to understand that. The key was probably put over to "port" or "starboard" (the torpedo turns very quickly), and she would probably turn round quicker than those unacquainted with her manipulation expected, forgetting the *key* was hard over, she was slewed round and came towards them, and they forget to turn the key off in their excitement. In the action between the "Huascar" and the "Cochrane" no Lays were used. It is of no use for any country or Government to buy the Lay, or any other torpedo, if they do not take the trouble to learn how to use it. The Chairman says experts are required. As regards the Lay I do not think an expert is required unless you call a sailor-man an expert. I do not call him an expert. I would go on board any ship you like, pick up a first-class boy, and he would work the Lay just as easily as I did. As regards the Berdan torpedo, it is not in a condition to be remarked about. There is no such thing as a Berdan torpedo. There is a Berdan torpedo on paper which is supposed to be a rocket torpedo. I believe the idea is that it is to go at double the speed of the Whitehead, to steer doubly as well, to dive under nets, and to come up above nets, and all this with rocket composition for its motor, and to be steered by two wires. I am afraid I have not been able to answer the questions very fully, but I have to thank you and Admiral Boys for your kind attention.

The CHAIRMAN: I am sure we shall all join in a vote of thanks to the lecturer for his very interesting paper.

Friday, January 26, 1883.

LIEUT.-GENERAL SIR C. P. BEAUCHAMP WALKER, K.C.B., &c., &c., in the Chair.

CYPRUS AS A STRATEGICAL POSITION.

By Sir SAMUEL WHITE BAKER, KT., M.A., F.R.S., &c.

(Read by Captain E. Palliser.)

THE Colonial Empire of Great Britain necessitates the command of all maritime highways. The population of thirty-five millions cannot be supplied by the limited area of our soil, and the food for a hungry multitude must depend mainly upon imports from distant countries. Statesmen should reflect upon the condition of England if embroiled in a great war with several maritime Powers as her opponents. Every highway would be menaced: freights and insurance would rise in proportion to the increased risks; and the price of corn would materially influence the political opinions of the British public.

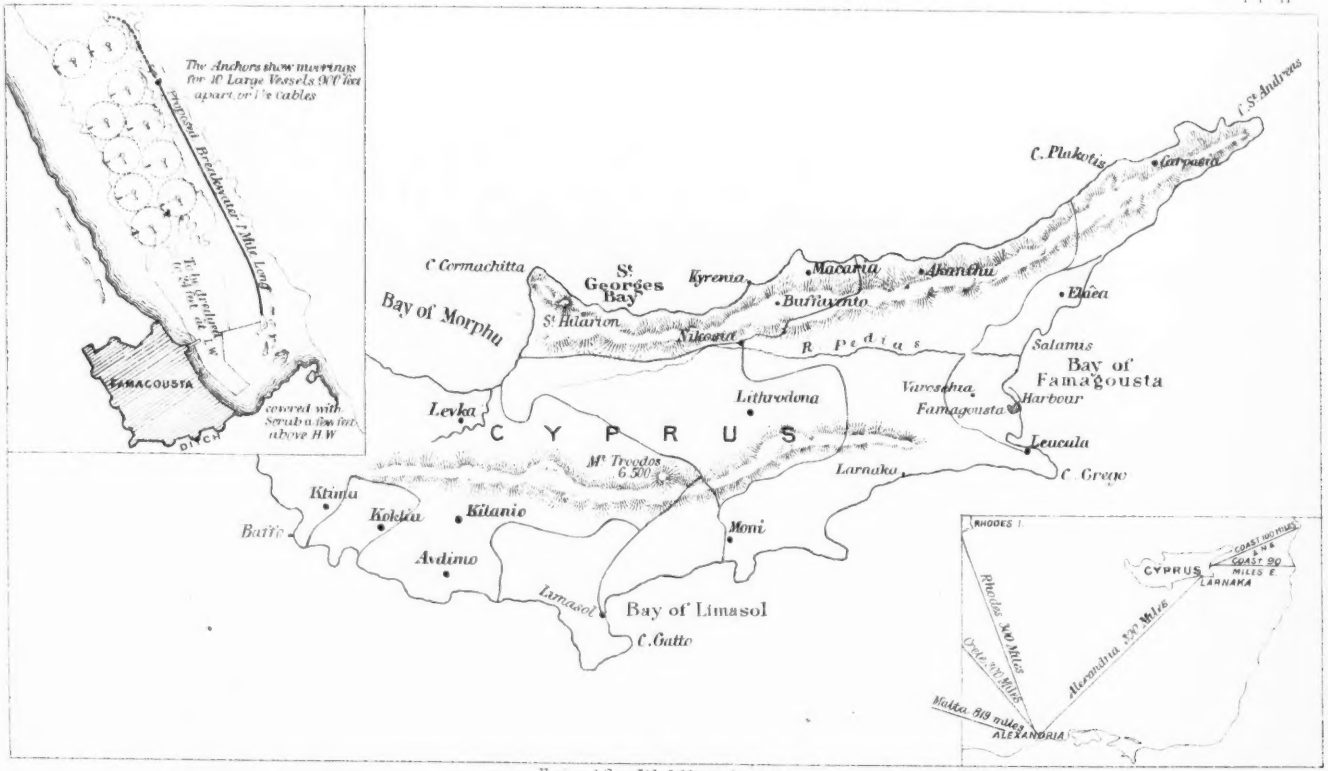
The first duty of a responsible Minister of the Crown is to ensure the safety of his country, and to provide in time of peace for the contingencies of war.

The improvements in naval architecture have entirely altered the conditions of warfare, and the first necessity which dominates the argument is a supply of that great generator of power, "coal," without which the strongest Navy would be impotent.

It is, therefore, incumbent upon our Government to secure certain positions throughout the seas and oceans of the world, which would ensure an unbroken chain of stations that could be relied upon as depôts for a coal supply; and at certain intervals to arrange facilities for the repairs of ironclad vessels, by the establishment of arsenals and dockyards.

The actual power of a country will be exhibited by the number and positions of its coaling stations, all of which must be fortified, as they would become the chief objects of an enemy's attack. It should also be remembered that a victorious naval action would probably necessitate repairs of vessels which could not be completed except within a dockyard, and that the highly complicated construction of our modern vessels renders such dockyards absolutely necessary throughout the principal commercial routes of Great Britain, which will be protected by the vessels of her Navy.

When Lord Beaconsfield astonished the world by the announcement



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that Cyprus was to be occupied by England as a *place d'armes*, there were conflicting opinions upon the importance of that island, which resulted in passive neglect, until the military and naval operations in Egypt necessitated its employment. It is a curious fact that at the commencement of the Egyptian disturbance Her Majesty's vessels were ordered to assemble in Suda Bay in Crete, although Cyprus was actually in our occupation and within twenty-four hours of Egypt! Questions upon this subject were asked in the House of Commons, and letters to the "Times" directed the attention of our authorities to the neglect of Cyprus, which was forthwith acknowledged as an important position. Depôts were formed upon the island, and it became useful as a sanatarium, although it had originally been condemned as a pestilential climate.

The attitude which England has recently assumed in Egypt compels us to examine the strategical value of Cyprus, which, by its geographical position, dominates the approach to Alexandria and Port Saïd.

The necessity of coaling-stations demands a chain connected at intervals of five days' steaming. From England to Port Saïd we possess Gibraltar, Malta, and Cyprus; the occupation of the latter completed the hitherto missing link.

Port Saïd, Suez, and Aden will continue the line of stations to the entrance of the Red Sea, and will practically secure our route to India.

An examination of Cyprus as a strategical position will induce a wide consideration of our actual position in Egypt. It may be argued by those opponents of the Cyprian occupation that the possession of Port Saïd and Alexandria would neutralize the value of Cyprus as a British possession, and that we should cling to an occupation of those important points in preference to a costly maintenance of a neglected island.

On the other hand, we must consider the various aspects without prejudice, and ask ourselves these questions: "If Egypt were independent of British control, could we afford to see France in the occupation of Cyprus?"

"If England were in permanent occupation of Egypt, could we permit a rival Power to establish a force in Cyprus?"

"If England were established both in Cyprus and in Egypt, would not the possession of the former guarantee the safety of the latter?"

"Would any Power venture to attack Egypt while Cyprus was a military and naval station, within a long day's steaming of Alexandria and a short day from Port Saïd?"

It appears to me that the island of Cyprus possesses immense geographical advantages; at the same time I admit certain drawbacks which it will be necessary to consider.

If we acknowledge the necessity of a coaling-station to complete the links from Gibraltar towards the East (supposing that Egypt is independent of Great Britain) there can be no doubt of the great importance of Cyprus, as our vessels would emerge from the port with full power to operate against an enemy's fleet in the Eastern Mediter-

ranean, or to blockade the coasts of Syria, only nine hours distant. Thus, as a coaling-station, the position would possess great geographical advantages, as Cyprus would form a centre with short radii to most important points, including Beyrout, Alexandretta, Smyrna, and the entrance of the Dardanelles, in addition to its acknowledged superiority as the sentinel of Egypt.

In regarding the military operations of a general European disturbance, the island of Crete would form an important strategical position in the hands of an enemy, if Cyprus were a portion of the Ottoman Empire as heretofore; but should Famagousta become a port and an arsenal in the hands of England, Crete would be paralyzed, as the occupant would be hemmed in upon west and east by Malta and Cyprus. When we consider the great varieties of ammunition, and its extreme weight as employed by modern naval artillery, it is highly important that stores should be supplied to every depôt, from which our vessels could draw in case of necessity. Thus Cyprus would form a convenient base for all operations in the Eastern portion of the Mediterranean, where our naval forces would be concentrated for the protection of the route to India.

If we agree in allotting to Cyprus the geographical position that is necessary as a valuable strategical point, we must examine the salient features of the island before we can determine upon the actual strength of the situation.

It is useless to refer to past history in order to prove the present importance of Cyprus; the conditions of warfare have entirely changed, and the relations of ancient wars have no affinity to those of modern times. We merely accept the position as one of strategical value, but at the same time we must demonstrate both the strong and the feeble features of the island as a *place d'armes*, for which it was specially occupied.

If England is to retain possession of the route to India, *she must be all-powerful at sea*, and her chain of stations will be merely harbours and depôts for her naval and military power; but in the absence of naval superiority, the line of fortified positions would simply represent a passive element of strength. These might be masked or blockaded by a superior naval force, and consequently rendered useless; the chain of stations will be of importance so long as our maritime power is in the ascendant. Should our fleet be absent from the coasts of Cyprus, an enemy could land without impediment upon various portions of the shores, and the chief arsenal or depôt must be prepared to resist an attack by land at the same time that it would be invested by sea; precisely under the same conditions that Famagousta was defended by the Venetians against the Turks.

In regarding the coast-line of Cyprus we must accept the difficulty of defending an island of 145 miles in length by about 50 in width, excepting the narrow extremity towards the east. Unless a large military force were stationed in the island it would be impossible to prevent a landing.

There are numerous little bays in secluded positions around the coasts which offer every facility for the disembarkation of troops On

the south-east, between Famagousta and Cape St. Andrea, the line is indented with innumerable sandy coves, which at present shelter the small coasting vessels in adverse weather.

The northern coast-line is more rugged, but nevertheless there would be no difficulty in landing upon various points, especially to the west of Kyrenia, where many small bays are formed by projecting promontories, and a sandy beach affords an easy approach.

Kyrenia was an ancient harbour of some importance, and the outer walls of the fort are in solid condition, but the port is too contracted for the entrance of modern vessels of war, and could only be used for the small trading ships which represent the local mercantile marine. Although the walls are of solid masonry, and about 70 feet above the bottom of the broad fosse, they would not sustain a regular attack by heavy metal. On the other hand, the position is important, as the fort not only commands the small harbour, but is the key of the approach to Nikosia by the north, which is only 17 miles distant.

The Carpas range of mountains rises like a wall to an elevation of about 3,000 feet parallel with the sea, from which the base is hardly 3 miles distant in the widest part, and is only 1 mile in width from the fortress of Kyrenia. It is exactly opposite this fort that the straight road ascends gradually to the foot of the difficult pass by which the mountain route leads to the capital, Nikosia. About 4 miles along the sea margin towards the west, the mountains ascend abruptly within a few hundred paces of the shore.

The difficulties of an invasion of Cyprus from the north would be extreme, owing to the natural impediment caused by the abrupt walls of the Carpas range of mountains. Although a landing might be easily effected, a comparatively small force might defend the passes against greatly superior numbers until the arrival of a relieving squadron would imprison the invaders between the sea and the extremely narrow base of the Carpas Mountains. Strong north-easterly gales render the approach to this coast dangerous, and no General would select any point upon the northern shores of Cyprus as a place of disembarkation.

The Bay of Morphu affords an uncertain refuge, but although the sandy coast appears to invite a landing, the surf breaks in shoal water at a considerable distance from the beach, which would endanger boats except in calm weather, and the anchorage is unsafe owing to the sandy and loose nature of the bottom.

On the whole northern shore there is no special point to invite attack except Kyrenia, where the old Venetian fortress still exists. As this commands the harbour, and also the approach to the pass over the Carpas range to Nikosia, it would be advisable to construct a few detached forts connecting the foot of the pass with the fort, which is little over a mile in distance. Such a line of defence would completely intersect the narrow base at a right angle with the sea and the perpendicular face of the mountain range between the castled crags of St. Hilarion and Buffavento. The natural facilities of the locality would render the construction of such a line of works an affair of a few weeks, which could be commenced only upon the approach of war.

The south coast of Cyprus is seldom exposed to storms, and although the only real harbour is confined to Famagousta, there are perfectly safe roadsteads with firm holding-ground in the Bays of Limasol and Larnaca. The former of these has always been selected as the place of disembarkation for an invading force, and it is difficult to conceive why it was neglected, and the preference accorded to Larnaca at the commencement of the British occupation in 1878. Limasol is a charming neighbourhood, abounding in evergreen caroub trees, which afford a shade within a few yards of the sea-margin. These sheltering trees may be counted by the hundred thousand, and would have given a cool welcome to the over-heated troops that were landed at Larnaca during a July sunshine, to sicken and fill the hospitals through exposure in a treeless wilderness. It is hard to imagine the reason which induced our authorities to select Larnaca as a landing-place. For a radius of 25 miles the country is an apparently barren waste of chalky surface, glistening with white marls and crystals of sulphate of lime; admirable ground for cereals, but burning hot during the summer months, and absolutely devoid of shade.

There could not be a worse station for troops than Larnaca, and the only reason that can be adduced for the fatal error of its selection was the comparative proximity of the inland capital, Nikosia, 28 miles distant.

It is well known that our troops sickened with malarious fever, and that the entire force would have been incapacitated from active service, had it become necessary, as was then anticipated. This distressing state of affairs stamped Cyprus as an unhealthy station, and the fact was seized upon by the political opponents of Lord Beaconsfield, and grievously exaggerated. It cannot be denied that an unprecedented rainfall during the winter and spring had saturated the soil, which, in the total absence of artificial drainage, had caused pestilential emanations.

At the same time that unusually adverse climatic conditions existed, the troops were disembarked upon a miserable coast without the necessary accommodation, and were overworked in a burning sun, and camped upon the margin of a reeking swamp at Larnaca. If the force had been landed at Limasol, each man would have had the advantage of a shady tree, beneath which the bell-tents would have been comparatively cool; at the same time the moral effect of a verdant country would have avoided the despondency created by a scene of scorching barrenness, such as was presented in the neighbourhood of Larnaca.

Limasol must become the chief port of Cyprus. It is the centre of the wine-producing districts, and the direct route towards the mountain sanatarium upon the Troödos range. A military road has been constructed to Plātraes, 30 miles distant, and the highest camp upon Mount Troödos is nearly 6,000 feet above the level of the sea, 35 miles from Limasol. The various elevations of Cyprus afford a continual graduation of temperature. The western and central portions of the island are peculiarly characterized by a series of plateaux at in-

creasing altitudes, which form natural terraces, and consequently vary in climatic phenomena.

It is hardly necessary that the sanatarium should be placed at 5,800 feet; as I proved by experience that an elevation of 4,500 ensures a most perfect temperature; but during the exceptional sickness of the troops in 1878 it was natural that the highest attainable elevation should have been selected.

Limasol being the important port in direct communication with the sanatarium, must be accepted as the future commercial centre, and as such it is at present entirely unprotected. There can be no doubt that if Cyprus is to become a British possession, both the ports of Limasol and of Larnaca must be protected by earthworks mounting heavy guns, that would prevent the sudden entrance of an enemy; otherwise the shipping and the towns themselves would remain at the mercy of the first attack. Even the small harbour of Baffo (Paphos) was considered to be worthy of protection, and should our Government decide upon the retention of Cyprus, the British flag which denotes the entrance to Baffo should either be hauled down, or supported by defensive batteries.

It will be clearly admitted by all parties that the present position of Cyprus is unsatisfactory, and it is impossible that the island can remain in a state of ruinous uncertainty—as a strategical point. If it is to become valuable, it must be fortified; in its present state it is utterly unprotected, as there is literally not one single gun in position! This after five years' occupation!

In my own opinion (and I believe I am supported by that of Lord Wolseley, who was High Commissioner in 1879) Cyprus would become an invaluable possession if *actually British*.

There are few places that combine an agricultural and commercial value together with an important strategical position; Cyprus possesses this combination.

Malta and Gibraltar are simply fortresses, which, in the event of siege, must depend upon their supplies that have been stored within their magazines. Cyprus is a productive country, not only self-supporting, but exporting wines and cereals; thus Cyprus could support an army independently of assistance from without. This is an important element of strength.

At the same time it may reasonably be argued that the extensive area which enables Cyprus to produce so largely is in itself a source of weakness, as the long coast-line must be defended.

To a certain extent this is correct, but on the other hand, if we accept the geographical conditions of Cyprus, coupled with the actual naval and military position of Great Britain, the defence of the coast-line dwindles into insignificance. The question is really this: "Would an enemy venture to land a force upon Cyprus, unless the maritime superiority of England was completely effaced?"

We will admit that owing to some necessity Cyprus may have been left unguarded, and that an adventurous enemy disembarks 10,000 men upon the coast. If the chief points, such as Famagousta, Larnaca, and Limasol, are fortified, the enemy's force must become prisoners

upon the arrival of the English fleet. They may have produced some temporary mischief, but the end must be certain; they must lay down their arms, as there would be no escape, and England could pour into the island any number of troops to overwhelm the invader.

As I before suggested, the value of Cyprus as a strategical position depends entirely upon our superiority at sea. There are numerous islands in the Eastern Mediterranean of great geographical importance, but they would be simply prisons to any occupant should the enemy have the command at sea. Cyprus would be the same; precisely as Crete and other islands would be at the mercy of England should a war arise with Turkey. If Cyprus had remained in the hands of Turkey, it must have abided the action of England in the event of war. If we look back to history we find that, in spite of the heroic resistance of the Venetians, Famagousta was at length forced to capitulate through famine, owing to the superiority of the Turks at sea. The rule will apply to every island; even to our own home, Great Britain.

Under these circumstances the invasion of Cyprus by an enemy is not to be expected; therefore the difficulty of protecting an extensive coast-line is reduced to a minimum. The necessary defences would be limited to the entrance of the two ports—Larnaca and Limasol—and to the two small harbours—Baffo and Kyrenia.

The engineer would devote his attention to the key of the position, Famagousta.

When considering the importance of Cyprus as a strategical position, we must at once face the existing difficulty of the "Convention." The island should belong absolutely to England. I will not venture upon diplomatic arrangements, as they are beside the present question, but I will simply appeal to common sense, which would refuse to sanction a large expenditure upon a position that forms a portion of the Ottoman Empire.

Before all questions Cyprus must be accepted as a part of the British dominions. Regarded in this light, the situation at once is changed. Capital would flow from the mother country. The value of land would be trebled in the first twelve months. The resources of the island would be rapidly developed, and Cyprus would in a few years represent the most flourishing colony of the British Empire. It would become the gem of the Mediterranean. This transformation from neglect and perplexity would be the immediate result of the confidence that would be established by the British acquisition.

Under these conditions there would be no dissentient voice, and Famagousta would become a stronghold of the first importance.

The main feature of this position consists in the reef of rocks which forms a natural sea-wall parallel with the shore, for a length of about a mile.

Although the neighbourhood of Famagousta is an undulating and almost treeless plain, every foot of which is more or less under cultivation, the surface soil is seldom above 2 feet in depth upon the higher land in the vicinity of the fortress. The substratum is sedimentary limestone, which would prevent an enemy from approaching by the ordinary

means of sapping, as it would be impossible to cut sufficiently deep for trenches. The Turks experienced this difficulty in 1571. The following notes were made upon the spot in 1879, and although the measurements are not absolutely exact, they are sufficiently correct to convey an idea of the position:—

"The walls of Famagousta are imposing; they are constructed of carefully squared stone, joined with cement of such extreme hardness that the weather has had no destructive effect. The perimeter of the fortress is about 4,000 yards; the shape is nearly a parallelogram. The fosse varies in depth and width, but the minimum of the former is 25 feet, and of the width, 80 feet, but in some places it exceeds 140 feet. This formidable ditch is cut out of the solid rock, which is the usual calcareous sedimentary limestone; the stone thus obtained has been used in the construction of the walls. The rock foundation would render all mining operations extremely difficult. The fire from the ramparts is increased by cavaliers of great size and strength, capable of mounting numerous heavy guns at a superior altitude. The only entrance from the land side is from the south-west corner; this is exceedingly striking, as the fosse is about 140 feet wide, the scarp and counterscarp almost perpendicular, being cut from the solid rock. A narrow stone bridge, upon arches spans this peculiar ditch, the communication depending upon a double drawbridge and portcullis.

"The parapets in the angles of the embrasures are 25 feet in thickness; and time appeared to be almost harmless in attacks against these piles of solid masonry.

"The water supply depends upon an aqueduct of several miles in length, as that produced by the wells within the walls is brackish. The aqueduct runs along a line of sandy heights before it enters the fort. The highest point of this position is about 600 yards from the gate of Famagousta. I counted the embrasures of six guns that could have been brought to bear exactly upon my tent 200 yards from the windmill of Varoschia. At the same time I remarked that we commanded the lower portion of the fortress, and could fire into the rear of the batteries upon the sea-wall within the water-gate, thus sweeping the guns in reverse at a most destructive range.

"The water-gate from the harbour is approached by a winding entrance beneath a powerful circular bastion from an extremely narrow quay, from which the remains of a once formidable mole projected about 120 yards into the sea, and commanded the inner harbour. A citadel that is separated from the main fortress by a wet ditch which communicates with the sea by an adit beneath the wall, commands the harbour upon the east side. This ditch is as usual scarped from the rock.

"There are three points adjacent to the fortress that demand the erection of detached forts. Although open to the east and south-east, Famagousta is the only real harbour in Cyprus available for large vessels, and there can be no doubt that a moderate outlay would make the additions requisite for a first-rate and impregnable arsenal and coaling-station.

"It was blowing a fresh gale from the south-east when I was upon the ramparts facing the sea above the water-gate, and an admirable example was displayed of the wave-breaking power of the long line of sunken reefs, which forms a continuation of those natural breakwaters above the surface that have created the harbour. A heavy surf exhibited a creamy streak along the margin of comparatively still water within the reefs for about a mile, parallel with the shore, comprising an area of about 700 yards width at the extremity of the sunken rocks, and 500 from the existing breakwater, exactly opposite the water-gate.

"The picture presented during the strong gale was thoroughly illustrative of the natural advantages and the future requirements of the harbour.

"The long line of reefs which form the outer protection, would, were they exposed in their whole length, represent an irregular incline from 12 feet above the sea-level at the southern end, to 3 fathoms *below* the surface at the northern extremity. A wedge laid with its broad base to the south would represent the inclination of this long line of useful reef, which can be converted into a sea-wall by simply filling-in with blocks of concrete to a sufficient height above the extreme water-mark. The ancient jetty which connects the small islands that form the northern head of the reef, is in itself an example of the necessity of such an extension throughout the line. A natural headland terminating in disconnected rocks upon the north boundary of the reef about half a mile above the fortress, is a secure protection from the sea, but it admits the silt. This has completely filled-in a considerable portion of the original harbour; were this sea-communication prevented by connecting the various reefs with the main headland, the evil would be at once removed, and the inclosed area might be cleansed by dredging.

"There are two enemies to be resisted,—the sea, and the silt. The latter has been and still is brought down by the Pedias River; this has entirely blocked the ancient harbour of Salamis, and partially destroyed that of Famagousta. The engineer has to repel these enemies, but he possesses a great advantage in the fact that Famagousta has already existed as a most important harbour, therefore he is not experimenting upon an unknown bottom. The line of reefs affords the engineer's chief desideratum, "a sound foundation;" and the materials for his concrete blocks are close at hand in the native rock from which Famagousta has been quarried, and in the island of Santorin from whence the *pozzolano* is supplied for hydraulic cement, only three days distant. Few places possess in so high a degree the natural advantages for becoming a first-class harbour, and it has been computed that about 300 acres of water can be converted into a wall-locked basin, with an entrance from the south that would be secure during all weathers.

"The fact should be remembered that Admiral Sir Geoffrey Hornby took the Mediterranean Fleet into the harbour of Famagousta in 1879, and anchored without difficulty."

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The foregoing opinions upon Cyprus and especially upon Famagousta must be accepted as non-professional, and simply as emanations from a common-sense observation of the island. It may be argued that Famagousta as a harbour could not protect a fleet, as it would remain exposed to the enemy's fire from seaward. On the other hand, the line of reefs would be steel-faced casemated batteries, *à fleur d'eau*, mounting 80-ton guns, while the ships within the harbour could fire above these batteries, and would be supported by the heavy metal of the fortress that would over-top the fire of the ships and reef defences. By land the investment of Famagousta would be almost impossible, as it is protected by the marsh of the Pedias River upon one side, and the detached forts would render an approach upon the remaining two sides extremely dangerous, while the difficulty of sapping through a rock substratum has already been explained.

In balancing the position, we must discard all party and political prejudices, and simply regard the island in its geographical position. If Cyprus were in the hands of an enemy, our commercial route to India would be imperilled, and our hold upon Egypt would be insecure. If in the hands of England, it may become the key of the position, and as a strategical point will dominate the eastern portion of the Mediterranean, and command the approach to Egypt, and the entire coasts of Syria.

In its present equivocal position it is useless except as a sanatarium. It necessitates the gravest attention of the British Government. If it is to become a permanent possession of Great Britain, we should at once decide upon the terms of acquisition. If it is to remain a vexed question under the terms of the original Convention, it will be absolutely valueless for the purpose which induced the occupation, "as a strategical point of vantage, and a *place d'armes*."

The CHAIRMAN: We shall be very happy to hear any remarks from any gentlemen present that will throw any light on the question of Cyprus, or afford some further information; if there is any gentleman present who has recently visited the island, perhaps he will be good enough to help us by starting the discussion.

Mr. WISELY, R.E.: Having been in the island of Cyprus the last four and a-half years, I should like to make an observation or two on what we have just heard. (1) With regard to choosing Larnaca rather than Limasol as a place for camping troops, I should think the principal reason was, that at the time of the occupation there was at Larnaca a good water supply. The Officers who went there were doubtless influenced in their choice by that consideration. At Limasol, which Sir Samuel Baker recommends in preference, there was at that time no good drinking water at all, except a limited supply brought in on donkeys from a distance of 4 or 5 miles, and even now there would be difficulty in providing water for a large body of troops. (2) Then the trade of Larnaca is certainly four times as much as that of Limasol, and the latter shows no signs as yet of taking the lead as a commercial port. It is shut out by the mountains and by distance from the rich corn-growing country in the centre of the island. (3) Then as to the question of fortifying Limasol or Larnaca, those who have been there will recollect that there is no regular harbour, no line of reefs on which forts could be built, and no facilities for making fortifications. They are roadsteads, open to the sea, and it would be extremely difficult to form any fortifications there to defend the anchorages. (4) The heights of Troödos, where the troops camp every summer, is

almost the only convenient place for placing a large body of men. Lower down, where Sir Samuel Baker was, there is room for about two battalions, but certainly not for more than that; on the higher levels there is room for 10,000 men, and the water sources are available for their use on three or four sides. (5) Then about Famagousta: in considering the question of fortifying Famagousta, the water supply has to be particularly attended to. It comes from beyond Varoschia along the coast, and would require to be well guarded. The position of Famagousta is upon a line of elevated ground, which terminates about 3 miles north, and runs about 3 miles south, where it joins the heights which bound the Messaria on the south. It is a rather narrow plateau, about a quarter of a mile wide, along the sea coast; then going inland from Famagousta one crosses a succession of two or three valleys, and lines of heights running approximately north and south, and then at about 2 or 3 miles distant there stretches away the plain of the Messaria. It would be rather difficult to defend a camp on the land side without throwing forts out on the heights beyond. (6) The idea as to Cyprus has been that it would be of advantage to England as a secure base of operations for carrying on a war in the corner of Asia Minor, Syria, or in Egypt, and at the time of the late war in Egypt, I believe we had orders to prepare for a very large body of men, which shows that Lord Wolseley's intention was to have made use of Cyprus as a base against Egypt. But it occurred to me, and no doubt it must have occurred to every one at the time, how very much more useful Cyprus would have been if we had had large magazines there, and a sheltered harbour and everything to make it of use as a base. Fortunately for us, we had not those troops thrown upon the island. It would have been very difficult to provide for their wants; but no doubt if a large sum of money was spent in fortifying and improving the harbour of Famagousta, making good magazines, and preparing for contingencies by keeping up great stores of material, then I think Cyprus would be of use to us as a military station—not only when a war is actually being undertaken in the neighbouring lands, but also before war is declared, and at the critical time. It will enable us to make there a strong military demonstration, by which very show of force, war may happily be averted.

Major CLAYTON, R.A.: I should like to refer to two points. In the first place, as regards the value of Cyprus during the recent campaign, I was in command of the depôt of artillery which was intended to be sent to Cyprus on that occasion. The history of what took place was this, that a certain part of my depôt started in the beginning of September for Cyprus, and arrived there in due course; but before the head-quarters of the depôt with myself were able to start, which we did on the day after the battle of Tel-el-Kebir, the orders came for us to go straight to Ismaïlia, and not to Cyprus at all: that is to say, the establishment of a depôt of artillery at Cyprus really broke down before it was absolutely carried out to its completion. Although the result of the splendid victory at Tel-el-Kebir rendered it unnecessary for any depôts to be formed at all, yet I think what happened proves tolerably well that the place for a depôt for operations in a foreign country is at the base of operations in the country itself, and not at a distance separated from that base by a considerable space of sea over which troops cannot be got in a hurry, without the delay and trouble of sending ships from the base to the depôt, embarking the troops, and bringing them back. The place for a depôt is nearer the base than a point separated by several hundred miles of sea. The second point is as regards the effect produced by the occupation of Cyprus by the English. In 1879 I was sent into the interior of Asia Minor to act as Consul, and remained there more than two years, and many a time have official Turks and others come to me and said, "What is it England wishes to do in Asia Minor?" My answer was, that we desired to have reforms carried out in order that the Turkish Empire might be strengthened and no excuse afforded to foreign Powers to interfere with its government. The reply always was, "Well, if that is the case, *why did you take Cyprus?* If your only object was the strengthening and the integrity of the Turkish Empire, why did you take Cyprus?" The idea among the Turks evidently was, that England was desirous of territorial acquisition, and nothing that I could say could remove this impression. Therefore, what I ask you to consider is, whether the strategical advantages, which no doubt exist to a certain extent in Cyprus, are worth the loss

of influence which I am certain England has experienced in the councils of the Turkish Empire on account of her having taken possession of that island.

Captain J. C. R. Colomb, R.M.A.: I should like to say a word, on the general question of Cyprus, as to its imperial strategical importance. I very greatly regret that Sir Samuel Baker is not here, because I am compelled to differ with his very opening sentence. He says, "The Colonial Empire of Great Britain necessitates the command of all maritime highways." I do not think the Colonial Empire creates the necessity, for I think the necessary command of the imperial highways necessitates the maintenance of our Colonial Empire. Our maritime supremacy rests upon the naval facilities our colonies afford to our fleets. Then, again, Sir Samuel Baker says that in a great war "with several maritime Powers" our highways would be menaced. I think he might have left out the "several" and have put in "one or two." "It is therefore," he continues, "incumbent upon our Government to secure certain positions throughout the seas and oceans of the world." I think we are all agreed upon that. I think the former Government was agreed upon that, because three-and-a-half years ago they appointed a Royal Commission, which has been sitting ever since, to point out what those positions are, and how they are to be defended. There is another question I was very anxious to ask Sir Samuel Baker, and that is, why he fixes the arbitrary limit of five days as the steaming distance between coaling-stations? I attribute no importance to the limit of time; I think the distance of your coaling-stations cannot be regulated in that arbitrary manner. The capacity of the bunkers of your ships and other circumstances will rule that question. Now I narrow down to the point of Cyprus particularly. Sir Samuel Baker asks this question: "If England were established both in Cyprus and in Egypt, would not the possession of the former guarantee the safety of the latter?" Well, I think that question may fairly be reversed in this way, "If England were established both in Cyprus and in Egypt, would not the possession of the latter guarantee the safety of the former?" I think the present political position of Cyprus is to be condemned: it is neither one thing nor the other. Supposing it becomes a British Colony, the question is whether, as an imperial position, it is worth the expenditure of a very considerable sum of money for its strengthening as a naval base. Now I object to that question being entirely treated with reference to one imperial road only. We must cut our garment according to our cloth, and the difficulty of arranging for the true defence of our Empire is the difficulty of money. Therefore, before anybody can rightly decide whether to expend a large sum of money for the purpose of creating a naval position considerably off any direct line and as a result to divide our forces,—because I maintain that Cyprus is useless as a protection to the Canal, for it is at the Canal we must defend it,—I say before you can decide whether, as an imperial question, the value of Cyprus is such as to warrant a large expenditure of money, you must look all round the Empire; you must be clear that it is *the one position* out of very many which requires the expenditure of that money most; and I do think, with Malta and Gibraltar, and the necessary precautions for securing the Canal at the Canal, that fact cannot be established. It would be rather tending to weakness than to strength to expend resources—sorely needed at positions commanding other lines of communication—on Cyprus. If we take the relative value of the equatorial crossing of the Atlantic, it is roughly 110,000,000*l.* a year, in round numbers, in value of British goods. Four years ago I estimated the value of British goods passing through the Canal at 82,000,000*l.* a year; the Government, I am happy to say, have since made an inquiry of the various Chambers of Commerce in the United Kingdom, and after great difficulty have ascertained that 92,000,000*l.*[1] of British goods pass annually by and through the Canal. So in value of British goods the equatorial Atlantic is more important than the Canal. Taking that ground alone the equatorial crossing, and the British ports in the vicinity, demand defence. There is not one position there, not a single coal depôt, with modern guns or adequate means of defence. Therefore,

[1] The difference between my estimate for the year 1878 and the Chamber of Commerce calculation for 1882 is fairly accounted for by the increase of traffic through the Canal in 1882 over that of 1878.—J. C. R. C. (*vide* "Naval Intelligence," &c.).

viewing the Canal as a trade line of communication, I say you cannot discuss imperial expenditure on Cyprus as an abstract question, alone and apart from all other considerations connected with the defence of other trade lines of your Empire; and I do believe, with Malta and Gibraltar secure, your truer policy would be not to expend more money on a Mediterranean base situated, as Cyprus is, at a considerable distance from your trade line. If you have money to spare, after securing bases on other seas, spend it on the Mediterranean fleet rather than on Mediterranean bases, so as to shut up the enemy's ports with a little more certainty than you are in a position to do now.

The CHAIRMAN: Captain Palliser, who has been good enough to read this paper for Sir Samuel Baker, tells me that he does not intend to reply to any of the remarks that have been made. I have therefore only two duties remaining to me. One is to declare the discussion closed. For my own part I shall offer no remarks, as I am particularly desirous not to talk on this subject. The other duty is to ask Captain Palliser to add to the kindness he has already shown us to-day by conveying your thanks to Sir Samuel Baker for a very interesting paper.

STEEL BULLET-PROOF "CART-SHIELD" FOR FIELD BATTERIES.[1]

By Sir SAMUEL WHITE BAKER, KT., M.A., F.R.S., &c.

(Read by Captain Palliser.)

THE Martini-Henry rifle in the hands of first-rate marksmen can be rendered effective against field artillery at a range of 2,000 yards, by the simple extension of the sights.

When the authorities shall have devoted the necessary attention to a development of rifle practice, we shall possess bodies of skilled marksmen, who will be educated to measure distances by the eye, and will receive extra pay in proportion to their efficiency. A certain number of these sharpshooters will be included in every regiment. Under certain conditions, a body of such scientific riflemen will be told off for the special service of silencing an enemy's guns, when unprotected by earthworks in the field.

At a range of 1,500 or 2,000 yards, ten men would be ordered to concentrate their fire upon one gun. Each man would lie flat upon the ground, or select the most convenient shelter and attitude for accurate firing, while in such a position he would be invisible at so great a distance, and practically invulnerable.

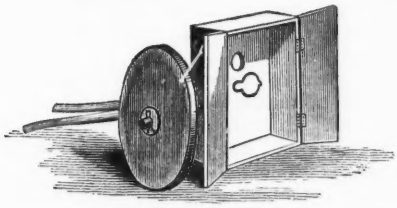
During the short and disastrous campaign in the Transvaal, we gained fatal experience in the power of rifle-fire to silence guns that were exposed to the accurate shooting of a well-sheltered enemy.

It has therefore become essential that the gunners and horses of a battery should be thoroughly protected against rifle bullets, by some arrangement of shields that will at once be portable and simple in the plan of adjustment.

The great weight of a steel shield would render any arrangement impossible, unless it can be provided with wheels. I have accordingly suggested an invention which combines extreme simplicity with great

[1] Read Friday, January 26th; Sir Beauchamp Walker, K.C.B., in the Chair.

strength, and produces a bullet-proof shield 10 feet in length, by 6 feet 6 inches in height. This shield can be arranged upon the field in about eight seconds, when the gun shall be brought into action.



The model, which is made to scale, represents a cart 6 feet 6 inches long by 16 inches deep, upon two wheels with broad overlapping tyres, to protect the spokes from bullets. The bottom of the cart is pierced by a port-hole for the gun; this is closed until required, by a movable slide, which allows the vehicle to be used for any ordinary purpose.

The sponges, water-buckets, &c., would be conveyed if necessary in the cart, together with a spare wheel.

The top or lid of this cart would be closed by two steel doors that would open like those of a wardrobe, and when the cart should be tilted, they would rest against the wheels.

Nothing could be more simple than this arrangement, which is only a modification of the usual method of tilting a cart to empty the contents.

Two horses would be harnessed, and as the weight of the steel top and bottom of the cart would not exceed 1,300 lbs., *i.e.*, 65 feet of $\frac{1}{2}$-inch steel at 20 lbs. per foot, they could travel at the same speed as horse artillery.

When brought into action, the cart would be tilted in two seconds in front of the gun. The doors would be flung open and laid against the wheels. The port slide would fall, and the gun-muzzle be run through. The shield would then represent an almost perpendicular face 6 inches higher than a tall man, and 10 feet wide, forming a covering of half-inch steel. The horses would be withdrawn to the rear, in a line with the shield, so as to be under cover from the line of fire. As each gun of the battery would be protected in a similar manner, the horses would be well secured.

A very few seconds would suffice to restore the cart-shield to its original position, should the battery be ordered to advance, or otherwise.

The hinges and fastenings in the model are not such as would be fitted in practice. The tilting catch would be a simple bolt, and the steel lids would be secured to the oak sides with powerful iron straps. The shafts should be steel—also the axle. The sides and ends of the cart would be 2-inch oak.

An argument may be used against the cart-shield, "that it is an

extra incumbrance, and requires two horses and two drivers, thus adding twelve drivers to the complement of the battery. On the other hand, it will save the ambulance corps and reduce the number of wounded men; it will preserve the efficiency of the battery by protecting both men and horses; and it will add a moral force to the gunners by the security afforded, which will ensure calm and steady firing.

Carts upon this principle would be invaluable in many circumstances, and there is no reason why they should not be used under a variety of conditions. In savage warfare, such as that in Zululand, they could be drawn up in a square at night, and when tilted, they would form an impenetrable wall of steel. Such a fort, which could be improvised in a few minutes, would be impregnable to an enemy unprovided with artillery, as riflemen would fire through the apertures specially arranged for that purpose. The system might be extended for the protection of infantry, as there is no limit to the modifications which might be made upon such much-needed constructions for a protection from the fire of long-range rifles.

It may be contended against this principle that the combination of shield and cart would encounter difficulties in practice; the cart would be overloaded, and thereby rendered inoperative. The temptation of a cart can never be resisted by the men, and all kinds of impedimenta would assuredly be added to the recognized load.

There is no absolute necessity for the combination. The shield would be even more practical should the sides be only 4 inches deep, so as to afford a simple impervious screen to the gun when the flap doors should be thrown open.

Captain R. F. JOHNSON, R.A.: Although half-an-inch of steel may be a very pleasant thing to get behind in action, I am afraid there are several points in the proposed shield which make it objectionable to artillerymen. In the first place, shields, if of use at all, would probably be of the greatest use at close quarters. If the guns have to retire in such circumstances, separate (*i.e.*, not attached to the gun carriage) shields would have to be abandoned. Again, aimed fire at long ranges is not so much to be feared as previous exertions, excitement, and smoke, which must spoil the very best shooting. The Transvaal War has often been brought forward as an example where the shield would have been useful; but the Boers were altogether an exceptional enemy, trained to shoot by habits of the chase. The protection against unaimed, or rather badly aimed long distance fire is not so great as would appear at first sight: for all the detachment, when they are working a gun, must be at least 5 feet from the shield except two of them, who would get inside the wheels (the wheels of a gun are 5 feet in diameter). Even at 1,500 yards' range a Gras bullet, just missing the top of the 6 ft. 6 in. shield, would hit a 5 ft. 8 in. man, 4 feet 6 inches behind it; while at 3,000 yards range, a Martini-Henry bullet would hit a man 2 feet behind the shield. Again, at a distance of 1,500 yards from the gun, a man 750 yards to one side of the perpendicular would be able to see the back of the wheels past the edge of a 10 ft. shield, and his range would be less than 1,700 yards. From this it follows that the protection of such a shield to the limbers and teams, 10 yards in rear of the gun, would be almost, if not absolutely *nil*; and this is a most important point, because it is the loss of horses and not of men that cripples field artillery in a long series of engagements. Perhaps the most serious objection of all is the increased size of the target that would be presented to the enemy to fire at; and it must be borne in mind that the pretty Aldershot practice of concealing the guns on the reverse slopes of a hill would not be possible in action on account of the recoil, and the labour entailed in

running up. The cart may certainly be tilted in two seconds, but it would be pretty smart work to get the horses unharnessed and unhooked and clear in one-and-a-half minutes; and during all this time the enemy would have raised in front of them, in every battery, a nice row of six targets, each 10 feet by 6 feet. The thickness of the proposed shields would be just sufficient to burst a common shell with a percussion fuze, but not to stop it; and if Lieutenant Hickman, at Kassassin, had had a couple of shield screens in front of his guns for the Egyptians to burst their percussion fuzes on he would probably not have been able to stop there like he did. The shields are 13 cwt., but with the heavily-tired wheels, steel shafts, and various other parts of the carriage, the total weight would not be very much less than 18 cwt., or 3 cwt. per horse too much for horse artillery. Again, whenever the men had to run up the gun after it was discharged they would be greatly exposed. The Russian artillerymen in the Shipka Pass found that they suffered most when they had to run up the guns to the parapets. A shield on the gun would run back with the gun; the men would always be closer to it, and the target presented by the gun need not be so very much increased in size; besides which the limber box might be armoured so that when lifted it would give considerable protection to the team if the back of the boxes was towards the gun. The great objection to shields on the gun limber is the extra weight. It is said the present weight carried is the greatest that is allowable, but the twelve horses necessary for this proposed cart would be able to pull, in two ammunition wagons—six horses apiece—2,400 lbs. weight of ammunition, which would allow the limbers to be considerably lightened, and also increase the total number of rounds carried by the battery, and with an improved construction of carriage might give 300 lbs. to a gun for a shield on the limber and on the gun carriage, and this, with judicious distribution, would probably be found quite sufficient: for half-an-inch of steel is more than is required to stop a bullet, even at close quarters. Supposing an extra amount of transport should be allowed to each battery of artillery—which is not at all likely for many reasons—then there are many other rival claims to be considered at the same time as those of shields: extra ammunition, extra spare horses, machine-guns to protect the flanks and meet infantry and cavalry at close quarters, and others. That the claim of shields does not necessarily outweigh all these others, is proved by the fact that artillery, in a way most perplexing to theorists, and most annoying to infantry, has in all recent wars more than once stood its ground at close quarters without overpowering loss.

The CHAIRMAN: Have you seen a shield in this country?

Captain JOHNSON: The Hotchkiss machine-gun is fitted with one. It weighs 150 lbs.

Captain BURGESS: Has it been introduced into any Service?

Captain JOHNSON: No.

The CHAIRMAN: Did not Colonel Brackenbury propose it at one time?

Captain JOHNSON: His proposal was, I believe, to carry shields in a wagon and put them down on the ground, so that many of the same objections hold good. I do not for a moment wish to deny that shields would be of great use to field artillery, but to point out that they must be permanently attached to the gun and limber. With regard to the high percentage of ricochet hits mentioned by Colonel Hale, it may be remarked that the experiments referred to were carried out on hard level sands peculiarly favourable to ricochet.

Major WALTER UNDERWOOD: About four years ago a Russian iron merchant informed me that he had a contract with the Russian Government to make, for experiment, some chain armour mantelets for embrasures. I am sorry to say I forget what weight he told me they were per square yard, but it was very small. They were to be hooked loosely on frames, so as to increase the resistance to the bullet by yielding on impact. It just struck me that shields might be so made of a very light description which would be bullet-proof at short ranges, and if they did the same work (being carried on the gun) as the heavy cart in the model now before us, they would obviate the objection to which Captain Johnson has referred, viz., requiring extra horse-power. At the Siege of Phalsbourg, in 1814, the French used "wagons blindés" in bringing in their rations under escort, to protect themselves from the fire of the German cavalry, and they are also mentioned in Ducrot's

"Defence of Paris" as being used for a similar purpose during the siege. Another remarkable fact is mentioned by Ducrot, viz., that the only successful attack by the French on the Prussian position at Le Bourget was made by means of *sap rollers*, or hollow cylinders filled with earth, the men lying beneath them and pushing them on. When I read this it appeared to me that some sort of lightly armed wheeled machine should be devised for infantry, who could thus advance rapidly to the attack, or, in other words, form a moving shelter trench.

General Lord CHELMSFORD: I should like to say a few words with reference to the proposal to use chain armour mantelets. I have no doubt that Sir Beauchamp Walker, and others in the room who were in the Crimea, remember the mantelet the Russians had in the Redan, Malakhoff, and other batteries, which was made of very stout rope, and was hung upon the guns exactly in the same way that the last speaker proposes to hang his chain armour mantelet. They must have been effective, because, when I went into those batteries after the siege was over, I did not see one that had been in any way pierced by the heavy fragments of shell or shot which had been fired against them. Some artillery officers here present may perhaps be able to say whether it would not be possible to carry a lighter rope mantelet, of similar description, on each field or horse artillery gun, to be placed over the muzzle of the gun when in action; hanging loose it would give with the impact of the shot, and thus afford protection from rifle bullets, and I believe also from fragments of shell, to the gunners behind it. I mention this as a rope mantelet was a feature in the Russian batteries in the Crimea, which I have never seen elsewhere, and which seemed to answer the purpose very admirably indeed.

Captain COCKBURN, late 42nd Highlanders: I wish to say one word in defence of these shields from the attack made upon them by Captain Johnson. Although it is quite true that the drop of a bullet at these long ranges would hit men very close behind the shield, still the shield would protect them from what is often more dangerous than direct, namely, ricochet shot, by which so many men get hit at long ranges. Years ago I proposed that every gun should carry a light steel shield, to be tilted forward as it was brought into action. They would form a cover for the gun and would be a very useful protection to the artillerymen, for I cannot see how they can possibly live with infantry, properly used in open order, converging their fire on the guns, without some such protection. I think I once before mentioned how at Lucknow, using rifles on rests, I was enabled to shut up the fire of a whole line of loopholes, at the range of from 100 to 200 yards' distance. It was the first time I discovered what a wonderful weapon the rifle was when properly used; previously to that I had an exceedingly poor opinion of it. I remember once seeing my company miss a whole body of cavalry at 100 yards' distance. The word of command was given in a great hurry, and the bullets went flying all over the plain. Ten companies of the 42nd, advancing in direct échelon from the left, wheeled to the right, doubled up the top of the ridge, and fired their volleys at the rebel cavalry on the plain below with much the same result. Now in the 42nd, at that moment, there were two men who won the first and third prizes in the Crimean army for shooting, which shows that it was neither the men nor the weapons that were at fault, but only the manner of misusing them. Altogether I do not think they killed more than five or six men, and as many horses, out of the whole ten volleys fired. Of course the rebels drew their picket pegs and were off after the first volley, and those killed were mostly at longer ranges.

Colonel LONSDALE HALE: With regard to ricochet firing, Colonel Fraser, in his elaborate report on the experiments at Dungeness, where the firing was mainly at long ranges, says that out of over 33,000 hits recorded on the targets, 22 per cent. were ricochets.

The CHAIRMAN: I am sure our thanks are due to Sir Samuel Baker for this interesting paper, and also to Captain Palliser for very kindly reading it. Our thanks are also due to those gentlemen who favour us with observations, which are certainly a most valuable part of our proceedings. I wish there were not such extreme modesty present amongst those who really have information, and who, if they thought quietly for a moment, would find their way to impart it to others. It is the most valuable part of our meetings.

Friday, February 2, 1883.

MAJOR-GENERAL SIR ANDREW CLARKE, K.C.M.G., C.I.E., C.B., R.E., Inspector-General of Fortifications and Director of Works, in the Chair.

THE USE AND APPLICATION OF MARINE FORCES; PAST, PRESENT, AND FUTURE.

By Captain J. C. R. COLOMB, F.S.S., F.R.G.S., Half-Pay Royal Marine Artillery.

Introductory.

THERE is no fighting force under the Crown less understood than the Marines. Few trouble themselves to know more than that they are useful. Why they exist or why they are useful are not questions which attract attention. Parliament always readily grants whatever is asked for their maintenance, and believes, without inquiry, the country gets full value in return. It is the only service taken, so to speak, on trust.

The marine forces of to-day consist of two corps, of an aggregate strength of 12,400 men. The Royal Marine Artillery represents the numerical equivalent of some sixteen batteries of Royal Artillery, the Royal Marine Light Infantry about ten battalions of the line. The national importance of these forces as a distinct element of the fighting strength of England may be best appreciated by remembering that they exceed by more than one-half the total strength of the British Army which fought at Inkerman. They cannot therefore be thought—as a distinct branch of Her Majesty's Service—too insignificant to be worthy of particular examination from a national point of view. It is precisely from this broad point of view they never are criticized, and, therefore, it may be a useful contribution to the literature of the Royal United Service Institution to offer some remarks bearing on a matter so little understood.

The present policy and practice of this country is to create, at a cost approaching 1,000,000*l.* a-year, a military force equivalent to sixteen batteries of artillery and ten battalions of the line, and hand these scientifically trained military bodies over to the Navy to do with them as it seems fit. It practically excludes the Officers of these highly trained troops from occupying any position of enlarged responsibilities or power outside the very narrow limits of their own peculiar service; it even excludes them from serving on commissions

and committees of inquiry into matters relating to affairs of war, though spending vast sums to make these Officers thoroughly efficient fighting Officers and leaders of men by land and sea. The country does this while the cry is for professional Officers, and the demand is for full value to be given in return for public money spent in the acquirement of professional knowledge. The present use and application of marine forces present a picture of confused anomalies and inconsistencies, but before proceeding to examine them with any detail it is necessary to trace them to their source.

Past.

The marine is a peculiarly English institution, and the prologue to his appearance on the stage of English history was that long constitutional struggle between the Crown and the people respecting the maintenance of armed forces. To keep in the King's pay "any other body of armed men save as a guard for the Royal person was a violation of the law."[1] Men might lawfully be pressed to work as sailors; it appeared no great stretch of prerogative to press men to fight the King's ships "as soldiers." It was illegal to land "press-men" in a foreign country, but soldiers in ships off an enemy's coast "only required a very little persuasion to land." This naval diversion of land forces, in order to evade the law, was the original conception which produced British Marines chiefly intended for offensive operations in foreign countries. During the Commonwealth England triumphed on the sea by the application of military power to naval purposes. Blake, for example, was only fifty-nine years old when he died, he had remained seven years at Oxford after taking his degree, and was over forty years of age before he took to arms. He was bordering on fifty when, as Colonel of Dragoons, with nothing but purely military experience, he was selected to command the fleet, and in nine years of sea service he made for himself fame, and for his country enduring maritime renown. He did this by bringing military experience to bear on naval practice. "He was the first man that infused that proportion of courage into seamen by making them see by experience what mighty things they could do if they were resolved; and taught them to fight in fire as well as upon water."[2] Blake was not a seaman, but a great sea soldier; in other words, a marine clothed with naval authority, and directing naval force during that transition period of separation between land service and sea service.

Five years after the death of Blake the 3rd Regiment of Foot was called the Admiral's or Maritime Regiment, being specially set apart for sea service.[3] Four years later the Foot Guards were appropriated to sea service. As these two events are the germs from which have been developed the marine forces of to-day, it may be as well to

[1] Clode.

[2] Clarendon.

[3] It is sufficient here to acknowledge generally information derived from "The Historical Records of the Royal Marine Forces," by Paul Harris Niccolas. [J. C. R. C.]

review briefly the condition of England and of her war forces at that time.

She was then self-containing and self-supporting a population far below her capabilities of natural producing power, greater only by a few thousand than that of London now. The defence of the sea was chiefly necessary for the safety of her own coasts, to secure supplies of luxuries and power of accumulating wealth. Her revenue was less than that now of the Colony of Queensland, founded only twenty years ago. The annual value of her exports was about half the value of the annual exports from Canada at present. The day of her Empire had, however, just begun to dawn. The East India Company had commenced its struggles for the far East, while English settlers were firmly establishing themselves on the American continent in the West. Her West African Company was flourishing in spite of the pestilential regions of the African forts, and her West Indian possessions were already sources of wealth and power. Her sea commerce was being extended by an odd mixture of lawless marauding and honest enterprise. Honest enterprise sent out its merchant fleets and looked for their return at fixed periods of the year, regulated by the nature of the trade and the geographical position of its foreign source. Thus it was by convoys sea trade was protected. But on the whole the attractions of a seafaring life in those days were freedom from the restraints of law, thus presenting an unlimited field for the exercise of uncontrolled individual enterprise, rapacity, and daring. Service at sea for the King was unpopular by reason of restraints necessarily imposed for public purposes. The Navy had to be manned by forcible impress. The streets were emptied of men, "men being so afraid of the press."[1] Naval administration was a "prodigy of wastefulness, corruption, and indolence; no estimate could be trusted, no contract was performed, no check was enforced."[2] The professional naval Officers bred to the sea "seemed a strange and savage race." "Their deportment was uncouth, their talk, where it was not made up of nautical phrases, was too commonly made up of oaths and curses."[3] But naval commands were chiefly held by court favourites wholly ignorant of all things appertaining to the sea, and not always acquainted with fighting on land. Captains and pursers cheated the King and defrauded the seamen. Discipline there was none; system there was none; and the ablest Admiralty official of the time was probably not far wrong in declaring that as things then were "the seamen of England, in my conscience, would, if they could, go over and serve the King of France or Holland rather than us."[4] The war ships of the time numbered some 140, having an aggregate of some 60,000 tons, carrying some 5,000 guns, and requiring about 30,000 men to man them, but many were rotten and unfit for service. Besides the Life and Foot Guards, the King's exertions had managed to preserve out of the forces drawn home from Tangier, one regiment of dragoons and five regiments of foot; one of these, "the 3rd," was the Admiral's

[1] Pepys. [2] Macaulay. [3] *Ibid.* [4] Pepys.

or Maritime Regiment; but the militia was the only military force recognized by law. Now, at this period, war operations on land had well-defined principles, and had been reduced to a system; war operations at sea were left "to every man's own conceit." "I have," says the author of the "Sea Grammar," printed about that time, "seene many bookes of the art of warre by land, and never any for the sea." The necessity for uniformity in discipline, in individual training, and even in dress was then well understood and acted upon in the Army; in the naval service then, and for nearly a hundred years afterwards, all these things were despised. It was not, therefore, unnatural to expect that by thrusting into the chaos of naval confusion a nucleus of fighting force drawn from a more advanced system beneficial results might follow. Perhaps it was thought that a little military leaven might leaven the whole naval lump of corruption and incapacity, but after all it was but a miserable expedient to try at a time when the necessity for separating land service from sea service was sufficiently apparent. While England thus fiddled with her naval forces by creating a maritime regiment, France boldly commenced a radical reform of her naval system. One year after the raising of our original marine force, she instituted the "*Inscription Maritime*," and next proceeded to educate her naval Officers. She attracted and absorbed the best merchant captains into her war navy, at the same time offered inducements to young gentlemen to embrace the sea as a profession of arms, founded schools for their special instruction, and a system of training for all ranks and classes of her war navy. At one sweep she eliminated the purely land element from her Navy, only permitting one military Officer[1] of particular reputation to retain a naval command. The difference of naval policy 200 years ago between France and England is stamped on their Navies of to-day. About one-seventh of the complement of a British ship-of-war are marines; none serve afloat in the fleets of France.

Our original maritime regiment, with its "yellow coats lined with red, its good firelocks and colours bearing the red cross of St. George and the rays of the sun issuing from each angle," disappeared with the Army of Charles II, of which it was an integral part.

Two new regiments of marines were raised in 1694 during the reign of William III. The House of Commons, fearing this to be an increase of the standing army, voted the supply on a resolution "that they were to be employed in the service of the Navy only." Only one regiment was to be on shore at a time; when on shore the men were to be employed in the dockyards, and to receive 6*d.* a-day extra for dockyard work. None of the Officers were to be sea commanders except the two Colonels. When serving afloat they were to be wholly under the command of naval Officers, but the men were to be paid and accounted for when afloat by their own Officers. This latter arrangement was a check against naval fraud but too common at that time. These regiments were disbanded three years later. It would appear they were raised in the hope of first obtaining men as

[1] Duquesne.

soldiers liable to sea service, and then when afloat of inducing them to become seamen. Captains were ordered to report periodically "the names of such soldiers as shall in any measure be made seamen, and how far each of them is qualified towards being an able seaman."

Shortly after the accession of Queen Anne a number of regiments of marines were raised, and the 30th, 31st, and 32nd Regiments of the Line were formed and served as marines. Independent companies of marines for the defence of West Indian Colonies were created. These forces were all under the charge of the Secretary at War. The idea of obtaining seamen through the marines appears to have been at that particular time abandoned. However, at the Peace of Utrecht, the whole marine service was disbanded. It reappeared as part of the Army in 1739. In 1740 three regiments of marines were raised in America, the Colonels being appointed by the Crown, the Captains by the provinces. In 1747 the marine service was transferred by warrant to the Admiralty, and wholly disappeared once more the following year, on the Treaty of Peace of Aix-la-Chapelle. In 1755 it reappeared again, and from that date to this its history has been continuous.

It is fitting here to point out one or two of the salient features of the use and application of the marines up to the time of their becoming a permanent institution.

The military arm in system and in mode of discipline and training was still far ahead of the Navy. The raw material could sooner be converted into a fighting man under military organization and system than evolved out of the chance conditions of a ship. When the stress of war came it found an ever-expanding fleet without any provision for manning it except force. Hence the Navy had to borrow fighting strength from the military arm. The marines of those days were not considered as a reserve for the Navy. They had no existence during intervals of peace, the force only came into being when war burst upon England, and disappeared again when peace was proclaimed. Its place was always in the front line, wherever fighting was to be done. The force was not scattered as now in small detachments, but was embarked in fleets by regiments. It was only in cases of absolute necessity, that a body of less than fifteen men under the command of an Officer, was permitted to be isolated in any one ship. There were no theories in those days, as now, that highly-trained troops were necessary to the performance of ships' duties of the most common and ordinary description. In peace the Navy did its own work afloat without the aid of marines. There were no ideas prevailing then that soldiers must have years of sea experience in order to be efficient marines in war. The marine force was not used as secondary to naval peace requirements, but directly applied to fulfil the conditions of war on the sea in a broader and more primary sense. The defence of our positions abroad open to sea attack, the seizure of similar positions in the hands of our enemies, these were the immediate objects for the use and application of marines during the first half of the eighteenth century. Gibraltar is one of the chief memorials of

their successful use and application. The national importance of the marine service in those days may be gathered from the fact that the Guards, Officers and men, furnished the nucleus of marine regiments raised in 1739. War on the sea was then, what it will be in the future, a struggle for positions commanding the sea, and troops independent of internal naval conditions were necessary to take and to keep such positions. In those days soldiers were transported in fighting ships, and therefore purely military forces often contributed not a little to what are now regarded only as seamen's triumphs.

But the conditions which made a Blake possible had gone for ever. The military reign on the sea was over. Capacity and knowledge in sea affairs was ousting slowly but surely courtly incompetency from naval commands, and sea service as a proper profession for English gentlemen was becoming the fashion. The Navy had so far advanced towards general ideas of system as to be granted a uniform, and a naval academy had been established, in 1729, for the education of young gentlemen for the sea service. Greenwich Hospital had been founded for necessitous sick and wounded seamen, but no comprehensive measures had been adopted for obtaining and training seamen for war service. Just previous to the formation of the present marine force it was proposed in Parliament "to register a certain number of seamen who for an annual stipend should be liable to serve when called upon." This proposal was, however, abandoned as unpopular. It was more popular to praise the seaman and to neglect him. The country, alarmed for its liberties, first by the presence of Dutch troops, and next by the growth of a standing army, took keen interest in the soldier; chiefly because it was afraid of him. Parliament insisted on annually reviewing the military code, the condition and treatment of the soldier. The Navy was not, could not, be a danger to civil liberty. No free-born Briton, who could avoid the press-gang, feared it, and therefore Parliament paid little or no attention to the naval code, or the condition and treatment of the seaman. When a naval operation did not satisfy public hopes, an Admiral was shot. When seamen were poisoned with loathsome food, fraudulently supplied, but little notice was taken. England was determined to have naval success, but troubled herself little to devise systematic means of attaining it. When fleets had suddenly to be manned, men were forced on board to be "their country's pride," whether they liked it or not. Neither the country nor the Parliament cared very much to look below the surface of naval affairs.

It was, however, becoming apparent to naval Officers of that period that a nucleus of disciplined men, trained to accurate use of weapons, was necessary in a ship-of-war, filled by force with untrained men, so that by "their expertness in handling arms they might incite our seamen to the imitation of them."[1] What a seaman was in those days it is really very hard now to say. In these days of steam and mastless ships a suggestion to use the Army as a nursery for seamen would be ridiculed; yet so far back as 1739, in days of purest seamanship, we

[1] Admiral Vernon, 1739.

find Admiral Vernon urging "the necessity of converting most of our marching regiments into marines, and if, as they became seamen, they were admitted to be discharged as such, that would make a good nursery for breeding them."

The advantages of system in the fleet of France was becoming apparent to our naval Officers, who were casting about for means to remedy the most glaring defects of the English Navy. To look to statesmanship for naval reforms was hopeless, to return to military interference in naval command was impossible; so when the pressure of preparation for war came in 1755 an expedient was resorted to in order to satisfy internal naval wants. It was to create military depôts from whence might be drawn as few or as many soldiers as ships might require to provide for deficiencies in numbers, true discipline, and efficiency in the use of arms. By abandoning the former regimental use and application of marines, the inconvenience of friction between naval and military authority would be avoided, and the Navy could thus reap what was sown by military Officers and Army training without being hampered by military interference of Officers of rank in the use and application of soldiers to naval purposes afloat. Hence when marines once more came into existence in 1755, they were not raised by regiments, but by companies, and formed into divisions or depôts at Portsmouth, Plymouth, and Chatham. The purchase of commissions was abolished, but interchange of appointment in the Army was for a time permitted. Soon even the practice of notifying in the "Gazette" the appointment of Officers in the marines fell into disuse, and later on the vacancies created by Officers killed in action were often for long periods left unfilled. What the Navy wanted was men not Officers, but still in landing operations it could not do without them, and even Officers were required afloat to keep their men expert in arms and to prevent them losing their military characteristics essential to their value. It was all-important that the marine should not degenerate into habits which his presence was to correct by example. The professional naval Officer, having wrested naval command from military hands, had no notion of jeopardizing his authority, but the country, having denied the Navy system, organization, or means of instruction, naval Officers were compelled to look outside their own service for the means to keep the Navy together and to perform its functions as a fighting force. In this strait they called on the soldier to help them, while suppressing as far as was practically possible both the military Officers and the military system of which that soldier was the product. The use and application of marines thus became wholly subordinated to internal naval requirements. They were the only individually and carefully trained men in the fleet, the only instructed fighting force which the country placed at the disposal of naval Officers.

During the last half of last century England was, except for a few brief intervals, at war all over the world. Sometimes she "fought for empire, sometimes she struggled for existence." Her fleet was ever increasing, but her policy was still not to attract, but to compel service in the Royal Navy. She denied to it what she was careful to

provide for her Army—system, means, time, and opportunities of instruction. The soldier's interests she looked after, of the seaman's she took but little heed. The marines, being soldiers, thus became possessed of individual rights and benefits from which the men of the Royal Navy were excluded. Thus marines could be obtained by voluntary enlistment, and after being carefully disciplined and trained, were freely used to force unwilling civilians on board the King's ships and to keep them there as Royal seamen. Thus the firm bayonets of the marines became the foundation on which rested the exercise of naval authority and the discipline of the English fleet. From being a useful fighting auxiliary adapted to naval wants the ever-accumulating naval necessities during the last half of last century transformed the marines into guardians of naval law and order. This change was gradually developed by the circumstances of the time. It was unobserved by the nation until it was complete. The century was about to close. Our great sea victories had confounded our enemies and amazed the world. England, girdled with a mighty fleet, feared nothing, when a thunderbolt, descending from a clear sky, plunged the nation in terror and dismay. The Funds fell with a crash, for—the seamen of the fleet had mutinied! With marines sitting on the safety-valves, naturally enough, no single sign nor warning of coming explosion was visible to the Officers of the fleet. The extent of the damage could not, in the panic and confusion, be at once ascertained. Perhaps the naval boiler had burst. Calmer survey, however, showed that the damage was not really great, though naval Officers had been thrust on shore and the marines overpowered. The seamen were ready to return to duty "if the enemy's fleet put to sea;" the marines did theirs regardless alike of the external danger and of the internal revolt. So military system, discipline, and training, triumphed over naval confusion. The Parliament which had denied the Royal Navy system and the seamen reasonable conditions of service was now compelled to bargain directly with the seamen, and matters were arranged between them, while naval Officers looked on. But from that hour marines came to be openly regarded as *the* reliable element in the fleet, a national necessity in use and application as the great police of the Navy. A great naval Officer, who, some years after the above events, suppressed with dauntless courage mutiny in his fleet while off the enemy's coast, described the marines as "England's sheet anchor." Well he might, for in those hours of his sorest trial he had found them his. It should be recollected that the tradition that a force of marines is necessary for police purposes in a ship-of-war comes down from times like those, and originated in days when seamen were obtained mostly by force and restrained chiefly by fear, when Captains visiting sick seamen in hospital on shore were instructed "to punish" ill-conducted patients, agreeably to the rules of the Navy, taking a boatswain's mate with them for the purpose,"[1] and when "the convalescent men" on board ship were ordered "to be employed picking oakum."[2]

[1] See orders of Lord St. Vincent. [2] *Ibid.*

Thus the last century closed on our Navy. Turning our eyes to France, she had developed her naval system and provided for her seamen waiting for embarkation comfortable naval barracks on shore,[1] while English Admirals were uselessly pointing to "a horrible scene of profligacy and debauchery" on board our harbour hulks, which were the depôts for our seamen.

At the commencement of the present century the marines were all infantry. In 1802 they were made a Royal corps at the earnest request of Lord St. Vincent, and it is a curious fact that delay in making the official announcement of that distinction arose from an unsuccessful struggle on the part of that great sea Officer to have inaugurated a new departure in the war arrangements of the country. It was this, that simultaneously with the order making marines "Royal," should be published another, "making service afloat as marines a part of the duty of every regiment of the line in rotation." This furnishes another proof that the "sea-legs" theory has come in with steam, and in days of pure seamanship it was not thought soldiers required much sea training to make them efficient as marines.

Science was slowly improving artillery, and a new naval want consequently came to be felt, viz., artillery knowledge. Once more the old expedient of turning to the Army for aid was resorted to, and detachments of Royal Artillery were embarked. The Naval Artillery School of France had been founded about a hundred years before our Navy in its distress called on land artillery to come out on the sea and help it. Much the same causes which broke up the marine regimental system produced so much friction that the Royal Artillery had to be withdrawn, and at the suggestion of Nelson, a new service, the Royal Marine Artillery, was created in 1804. This corps was organized out of Officers and men picked from the Royal Marines, then 29,000 strong, and after careful training and instruction in artillery became the one and only scientific artillery nucleus of the whole Royal Navy. Unregarded by the nation or the Navy, this was the corps which quietly and noiselessly pioneered the way for the march of naval gunnery progress. Its work produced in 1832 a purely naval gunnery school, the "Excellent," where selected naval Officers and seamen were put through a short course of artillery instruction. This establishment still exists, but much developed and carefully improved.

The Marine Artillery was then thought to have sufficiently cleared the way for the Navy, so it was abolished, and the corps of which the conqueror of Scinde had written, "Never in my life have I seen soldiers like the Marine Artillery,"[2] was unceremoniously turned out into the streets of Portsmouth. The Royal Marines thus once more became a single corps of infantry. Repentance quickly followed the act of abolition, and the experiment of 1755, as regards the whole marine force, was at once repeated in another and smaller way in respect of artillery naval deficiencies. It was to organize com-

[1] 1786.

[2] "Life of General Sir Charles James Napier."

panies of "Marine Infantry Artillery," and two were formed. They were not permitted to assume even the name of the old corps they represented, but were unobserved to do pretty much the same work. These companies grew in number and in strength, and in 1841, to qualify as an Officer of the artillery companies of Royal Marines required a longer time of preliminary preparation at the public expense, and passing a higher theoretical standard of scientific knowledge than was obligatory on any combatant Officers, gunnery or otherwise, in the entire Royal Navy. These artillery Officers in official disguise were sometimes employed as gunnery Officers of ships, sometimes as simple marine Officers. It was a matter more or less for the discretion of Captains of ships. The non-commissioned officers and men were freely used to fit gun gear and to teach the seamen gunnery, just as corresponding grades in the infantry companies taught seamen the use of small-arms, and to drill as soldiers. The marines had by 1850 thus added to their uses and applications. At this date the non-commissioned officers and men, being soldiers, had, following in the wake of the Army, obtained many solid benefits and attractive advantages, still denied to the petty officers and seamen of the Royal Navy. The Army, at the commencement of this century, had been granted a system of continuous service, which was subsequently always in a state of progressive improvement, and in which marines by degrees participated. The Royal Navy had in 1850 no continuous service system. Its peace demands for men could be supplied without actual resort to physical force. To serve the Queen at sea, men had no longer to be dragged, but sometimes to be drugged. Instead of being seized in the open streets by the "press-gangs," they were cautiously cajoled in grog-shops in the back slums. Newly commissioned ships, with a careful assortment of naval Officers and full complements of marines, thus making complete all appliances for discipline, often waited vainly for weeks without tempting sufficient numbers of blue-jackets to walk in. When filled up the ship proceeded to sea, and at the end of the commission spent in training and disciplining them, the blue-jackets were cast adrift, while the marines returned to their barracks to get a furlough, and then to be re-trained by their own Officers to make them fit for re-embarkation.

The year 1853 witnessed the first touch of broad true statesmanship to the Royal Navy during that long period over which we have travelled, of 188 years. The Naval Continuous Service Act of that year placed the Royal seaman—as regards conditions of service—on a level with his comrade the British marine. Thus a new chapter of naval history was begun just thirty years ago.

During the Baltic and Crimean Campaigns a portion of the artillery companies was specially used and applied under the command of its own Officers in mortar-boat flotillas. For many reasons the Navy was incapable, at the time, of fulfilling this requirement, so the force was put to do the work which in 1804 the old Marine Artillery had been created to perform. In 1859 these companies were formed into a separate division, and in 1862 into a separate corps, and given back

the old name Royal Marine Artillery. Thus the marines became once more forces composed of two corps.

In 1858 a Royal Commission was appointed to enquire into the best means of manning the Navy, and on its report, the following year, is founded our naval system as it exists to-day. The chief representative of the mercantile marine on the Commission declined to sign the report, and set forth his reasons and his views separately. His objections to the report were that various important facts had been overlooked or treated as of secondary importance. The first and foremost fact was, in Mr. Lindsay's opinion, this:—"That the introduction of steam had entirely changed the mode in which naval warfare would in future be conducted." It is extraordinary that the Report of the Commission on which is based our naval system of to-day ignores steam utterly. Even the word "STEAM" is not to be found in the whole report; this is worth particular notice, because another Royal Commission on "The Defences of the United Kingdom," sitting at the time, devoted a lengthy paragraph, explaining that steam had "revolutionized naval warfare." The Manning Commission, however, expressed the opinion that it was improvements in gunnery which had "effected a complete revolution in naval warfare,"[1] the consequence being that the present perplexing naval problem is—how to fit into a steam navy a makeshift organization adapted to a sailing navy? It is a large question, and I would refer the uninitiated to the most valuable prize and other naval essays published[2] last year by this Institution, and also to the report of the discussion on them, which will be found in the Journal.[3] We can only consider one portion of the problem—the use and application of marines. On this point the Royal Commission report throws practically no light. Though it examined seventy-nine witnesses, not one single Officer of Marine Artillery or Marine Infantry was called. A pay sergeant was asked some questions about pay and clothes, and that was all the direct evidence given on behalf of artillery and infantry forces on which the Navy relies, and numerically far greater than the total force which marched under Roberts from Cabul to Candahar. A single special paragraph in a very voluminous report of twenty-one pages finishes off marines in four sentences. The first sentence is simply this: "The marines are a useful and efficient body of men, second to none in the service of the State; they are excellent troops, both as artillerymen and infantry, and are at the same time capable of performing many of the deck duties of a ship-of-war." Since that vague sentence was penned, steam has quietly tumbled *all* duties in modern ships of war down to the deck, thus correspondingly altering the qualifications of men required to fight them. The second sentence in the paragraph of the report devoted to marines is as follows:—"There is, however, a limit beyond which they cannot be conveniently increased, for it is necessary to their efficiency that they should spend a large portion of their time afloat." What proportion it does not say. The third

[1] *Vide* "Report," page 11, para. 32.
[2] *Vide* "Journal," vol. xxiv, No. CXIV, page 183.
[3] *Vide* "Journal," vol. xxiv, No. CXVII, page 593.

sentence states that "there is ordinarily a reserve of 6,000 marines in the home ports ready for active service afloat," which was not and is not the case; and the fourth and last sentence recommends an increase of the force—it does not specify whether the Marine Artillery or the Infantry, or both—by 5,000, and which recommendation has not been acted upon. Thus the first sentence tells nothing definite as to use and application, the second is mysterious, the third is incorrect, the fourth and last has been ignored, and therefore the whole paragraph is valueless for practical purposes now. Thus were the marine forces officially launched blindfold into the future of that reconstructed Navy, which dates from that report. On the other hand, Mr. Lindsay, taking the ground of alterations caused by steam and "mechanical contrivances," and his personal knowledge of the mercantile marine, refused to sign the report, and advocated a comprehensive application of marine forces to the purposes of modern naval war. Before, however, discussing matters of opinion as to the use and application of marine forces, it is necessary to complete the series of facts.

The last point we noticed as regards education of naval Officers, was the founding of the Naval Academy in 1729. The name was changed to the Royal Naval College in 1806. The establishment was closed in 1837. In 1839 it was re-opened, not as formerly a place of preliminary education for young gentlemen entering the Navy, but for the scientific education of a certain number of Officers. It was here the Marine Artillery Officers were educated as scientific Officers at the public expense. This establishment gave way to the existing Royal Naval College, Greenwich. Candidates for commissions in the Royal Marine Artillery have first to qualify at the entrance examination for the Royal Military Academy, Woolwich, they are then attached "on probation" to the Royal Naval College, Greenwich, for two years, and must pass a series of examinations before obtaining their commissions in the Royal Marine Artillery. The theoretical scientific standard to qualify for a commission in the Royal Marine Artillery is higher than is obligatory for any combatant Officer of the Royal Navy, and I believe more than half the Officers on probation to so qualify, fail to pass it. The cost of such education at the College is defrayed by the public. Officers of both branches of the marine forces are, under certain conditions, allowed, in common with naval Officers, to study voluntarily at this establishment, and their expenses while so doing are at the public charge. Officers of the marine forces are further permitted to study and to qualify at the Staff College of the Army. This is also at the public expense, so these Officers, one way or another, cost a considerable sum of public money for their scientific and professional education. It takes about three and a-half years of an elaborate course of study and practical artillery training, at the expense of the State, to turn out an effective Marine Artillery Officer ready for service. He will then be about twenty years of age, and for pay alone he will have cost the country about 350*l*. The time occupied in training an infantry Officer is some eighteen months, costing for pay about 150*l*. He will also be about twenty years old when fit for service. The limit of age for candidates for admission to the Naval College to

study "on probation" for the Marine Artillery, is from 16 to 18—for a commission in the infantry from 17 to 20. The education of an executive or combatant naval Officer, at the expense of the State, begins with the child entering his teens on board the "Britannia"; two years after, it places him as a midshipman in a vessel of war, nominally as an Officer, really as a "school boy."[1] "His intellectual advancement," we are told, "during the most valuable interval between the ages of 15 and 19, has comparatively ceased, and that period may be considered as one of mental inactivity." It is not easy to say exactly what the pay cost of a combatant naval Officer has been when he arrives at the age of twenty, but, so far as I have been able to ascertain, I think it may be taken at a figure considerably less than that of the Marine Artillery Officer of the same age, and at more than the cost of an Officer of Marine Infantry. If examinations be any test, and if the naval account of the naval Officer's education as stated by naval Officers themselves, be at all correct, one thing is clear, viz., that the Marine Artillery Officer at twenty must be the superior of the combatant naval Officer of the same age in general knowledge, in scientific attainments, and in practical artillery training. This relative superiority is not of course due to anything else but the process to which the young men are respectively submitted, and by which they are tested. The State has thus arranged it, and bears the cost. As regards the infantry Officer of twenty, he ought to possess more general knowlege than his naval comrade of the same age, if naval Officers are right as regards their own educational system, but most certainly he knows thoroughly how to command men fighting as infantry, and is therefore far and away the naval Officer's superior in that particular respect. About, or soon after twenty, the naval Officer is put through a course, theoretical and practical, at the College and on board the "Excellent," and must pass a certain standard before receiving his commission as a Lieutenant. Thus, at the age when Marine Artillery and Infantry Officers are embarked as trained Officers in their respective branches, the naval Officers are disembarked to complete their professional education.

Present.

Now, as to use and application. It is not necessary to refer to marine forces when serving as part of the Army. Their duties as compared with the Army are identical, they are applied precisely in the same way under equal conditions and on exactly the same footing, being under their own Officers and under the Army Discipline Act.[2]

For example, quite recently in Egypt the Royal Marine Light Infantry formed an integral portion of the military force; while the Royal Marine Artillery, besides serving as infantry during the campaign, detached men to work the guns of the Royal Horse Artillery when the R.H.A. gunners were exhausted with over-work and fatigue;

[1] *Vide* Naval Prize Essay, by Captain Lindesay Brine, R.N., "Journal," vol. xxvi, page 210.

[2] The first Marine Mutiny Act (Annual) was passed in the reign of William III.

subsequently another detachment built up, out of the *débris* of the enemy's Krupp guns captured, one complete gun and fought it with effect, and finally the whole force of Royal Marine Artillery was employed as corps artillery, and entrained, &c., the guns captured at Tel-el-Kebir.

When, however, Marine Artillery or Infantry Officers are landed as part of a naval force for fighting on shore they are under the Navy Discipline Act and the command, direction, and control of naval Officers. So that Officers, carefully and specially trained by the State for military operations on the land, are placed in the face of an enemy under the guidance and direction of Officers carefully and specially trained for naval operations on the water. The gunnery duties of the fleet are performed by naval Lieutenants who have undergone special training and examinations to qualify for the position. When afloat the Marine Artillery Officer has no distinctive general artillery duties in the fleet. Their superior education and practical artillery knowledge, acquired at the expense of the State in order to fit them for duty as naval artillerists, are for general naval purposes neither used nor applied. A Major or Captain of artillery, expensively educated as such, and who may in pay alone have cost some 3,000*l.*, is simply, when embarked, an irresponsible spectator of the artillery work of the ship or fleet. The Marine Infantry Officer in like manner, educated at the public cost to be a carefully trained instructor in the use of arms and infantry drill, looks on, doing nothing,[1] while the naval Gunnery Lieutenant is teaching small-arm parties these very things. The duties afloat of Officers of both corps are confined to their own men, and only then when the general duties of the ship permit.

The Royal Navy may be grouped under two heads, viz.:—Combatant and non-combatant. Neither Officers nor men of the non-combatant division can be regarded as trained to arms, capable of defending their own ship, for taking an enemy's, or of landing as an organized force. More need not be said here about this division, except that about three-sevenths of a ship's complement is non-combatant, and under existing arrangements it is an increasing element. The combatant branch is the only trained fighting element in the Navy, apart from marines. As regards men, there are but 20,000 borne for service in the fleet, and this number includes petty officers. There are in addition 4,000 held in reserve in the Coast-guard. The total number of combatant commissioned naval Officers over twenty years of age of all ranks on the active list[2] is somewhere about 2,000, so that the total combatant or trained fighting element in the whole Royal Navy may be roughly computed at or about 26,000, all

[1] "There can be no doubt whatever that the enforced idleness of Marine Officers afloat is most prejudicial to both services, and we need ask ourselves can we, in ships of the future any more than in ships of the present day, afford to have Officers afloat who have no defined duties? It is a very remarkable point, one of the most curious things in the whole of our naval discipline, that the 'Queen's Regulations' and the 'Admiralty Instructions' contain no instructions on that head at all."—Commodore Goodenough. "Journal," vol. xv, page 493.

[2] On full or half-pay.

ranks. As regards marine forces, the rough numbers I have given, namely, the artillery corps, 2,532; the infantry corps, 9,826; are all fighting men and include all ranks. There are about 90 Officers of artillery and some 250 infantry. So that the total specially trained fighting forces of England for sea service are about two-thirds naval and one-third marine. It may be remarked in passing that there are three Naval Lords of the Admiralty, but no Marine. There are generally between 6,000 and 7,000 of these troops afloat, and if from the balance on shore, the drill staff, &c., and men in process of training, be deducted, there are ordinarily between 3,000 and 4,000, "ready for active service afloat," and not 6,000 as stated by the Royal Commission. The available reserve of marine forces, therefore, may be taken at something numerically less than the Coastguard.

The conditions of service as regards time, pay, and pension are now rather better for blue-jackets than for marines. To the actual cost of maintaining 20,000 seamen and 4,000 Coastguard, and providing pensions, must be added the cost of training 5,000 boys to keep up the supply, and these are non-effective as fighting men until they have grown to be men. The State incurs no such preliminary charge on account of marine forces, for only men are enlisted in the ranks. From the date of enlistment, it takes about two years to make a marine artillery gunner, about one year to make a marine private.[1] Not many gunners of marine artillery and privates of infantry have completed training and embark before they are twenty-one years of age. On the other hand, the Naval Prize Essay shows that of the total 20,000 combatant seamen borne for actual service in the fleet, some 9,000—nearly half—are not over twenty-one years of age. The important element of fully matured manhood in a fighting force is greater therefore in the marine than in the naval combatant portion of the fleet. The men are chiefly used and applied afloat as sentries, and next, to such general work of the ship under naval Officers as may be required. These men are supposed to be placed at the ship's guns in such a manner as will least impair the efficiency of the arrangements for action in case they should be landed, the marine artillerymen being given the most important numbers. This is an elastic general rule, variously interpreted. When the carefully trained and re-trained gunner embarks, perhaps for the third or fourth time, it is uncertain whether he will be put at a gun, and if put, he may find himself in a subordinate position under a young blue-jacket, as captain of the gun, who has not *been so long at sea*. The reason of this was explained by Admiral Sir T. Maitland (afterwards Lord Lauderdale), who had been for many years the head of the Gunnery Department of the Navy. He stated to the Commissioners: "I consider the marine artillerymen the most valuable men in Her Majesty's Service, and also the marines; but still the marine artilleryman, I think, is totally thrown away on board ship; for if we can get a seaman capable of being captain of a gun, we put him to it because we do not like the guns of the Navy taken out of our hands; and the consequence is

[1] Officers and men of the infantry are carefully instructed in ship's gun-drill as a part of their training previous to embarkation.

that a marine artilleryman, except when sent ashore with a field-piece, very seldom does his legitimate duty."[1] The machine-gun now often supplements the field-piece in naval operations ashore since that evidence was given. As a matter of fact it is seamen, not marine artillerymen, who are sent on shore from a fleet with Gatlings and field-pieces, and therefore, neither ashore nor afloat with naval forces does the marine artilleryman do his legitimate duty for which he has been trained at the cost of the nation. Now the Royal Commission of 1859 does not seem by their report ever to have understood that there was a specially trained marine artillery force. In the absence of any witness belonging to either branch of the marine forces they were naturally uninformed. For example, Admiral Sir A. Milne was asked: "The question is whether you can train the marines to fight the guns as well as sailors: what objection would there be to substituting marines for sailors?" His reply was, "Because you would not have a sufficient number of seamen to go aloft!"[2] If this answer be applied relative to working the guns of a mastless ironclad of the present time with no "aloft for seamen to go to," where are we? I say boldly, and at once, I entirely sympathise with naval Officers in disliking to have "the guns of the Navy taken out of their hands." I perfectly understand their feelings and applaud them for their "*esprit de corps*," but it is impossible to believe that our national system can be anything but most false, to tolerate the misuse and misapplication of the public money by the creation of a corps of splendid land or sea artillery for the distinct and settled purpose of allowing it to be "totally thrown away on board ship."

It is now time to compare the past with the present. We have seen that the origin of marines was due to political causes; these have wholly disappeared. We have seen that the original application of marines was for offensive operations on land in days when war-ships carried the military force. In these days, military forces are moved for offensive operations in special swift steam transports, for modern men-of-war cannot carry them. The military arm was introduced into the Navy to check fraud and corruption, but fraud and corruption have long since utterly disappeared. Marines were raised in the time of William III to feed the Navy: that use and application failed. During the reigns of Queen Anne, George I and II, numerous regiments of marines were raised only for war, and were carried in war fleets to seize, hold, or defend important positions commanding the sea. War ships have not now the space available, and cannot carry bodies of marine forces over and above their complements for that special purpose. If they use the fighting portion of their complement to hold or defend such portions, they are tethered to the place for want of a fighting force on board. The next use and application of marines from the time of George II down to the end of last century was to put supernumerary fighting men into ships capable of carrying them, and, at the same time, to provide "sealed patterns" as it were "of expertness in the use of arms to incite seamen to the

[1] *Vide* Minutes of Evidence, Question 5623. Manning the Navy.
[2] *Ibid.*, Question 147.

imitation of them." Now the ships cannot carry supernumerary fighting men, and as we have seen the young seaman is put captain of a gun "to incite" the old trained marine artilleryman to the imitation of *him*, while it is not an uncommon occurrence for marine artillery and infantry men to be left on board to take care of the ship, or in rear on shore, while seamen are pushed up to the front in naval brigades with the Army. So from inciting seamen afloat "to expertness" by marines, we have got to seamen "inciting" marines ashore.

From the end of the last century down to a time not possible to define, the marines were, and perhaps by some few still are, regarded as the police of the fleet. Since, however, the conditions of service of the seamen are now as voluntary and are rather better than those of the marines, and as the seamen are trained from boyhood, while the marines are men when they enter, that use and application of marines is wholly a dream of the past. If blue-jackets, trained from boyhood, cannot do the simple ordinary duties of guards and sentries on board their own ships, they cannot perform that commonest element of military duty on shore; and if that were the case they could not and should not be landed to serve with the Army in naval brigades in the presence of the enemy. Underlying, however, all past uses and applications of marines, there was one general reason for their existence, viz., the difficulty of obtaining sufficient men to man the fleet. War-ships were built rapidly by scores and taken or lost by dozens. Now war-ships take years to produce, and are built by ones and twos. Formerly war-ships were floating beehives, into which men were swarmed by the nation. Engines and machinery have turned out the men, and the chief difficulty now as to cost and time is ships—not men. Science has changed the relations between quantity and quality in manning the war fleet. Let us see how all this influences the present conditions of the Navy and Marines.

The marine forces have come to be described as a reserve for the Navy, for example—the Naval Prize Essay states, "the marines must also be considered as forming one of the main elements of our standing reserves." This is pure delusion. No body actually and continuously serving in peace with another force can be its reserve, therefore the 6,000 or 7,000 of these troops afloat in the fleet are not a reserve at all; of the remainder there are only between 3,000 and 4,000 which can be drawn out for active service. This number even cannot be regarded as available to meet a sudden increase in the fleet, for primarily it is the reserve to supply the waste in the 6,000 or 7,000 troops already afloat; besides, a very considerable proportion of these men are recruits, and have never been to sea. If then it be true that a man is not an efficient marine until he has spent "*a large portion of his time afloat*,"[1] these recruits must all be struck out of calculation. There will be then but a handful of men left. Thus the prevailing unthoughtful assertion that the "marine forces are the standing reserve for the Navy" comes to this: the country is spending nearly one million a year to have as a result a few hundred marines ready in

[1] *Vide* Royal Commission. Manning the Fleet.

barracks to meet sudden naval emergencies. But while it is so commonly and loudly asserted that a marine must spend a large portion of time afloat to be efficient, no First Lord, no naval authority, nor any one else has ever, so far as I am aware—authoritatively or otherwise—specified how long. What are the limits fixed by the modern "sea leg" theory, or by what standard is the necessary time to be measured? I commend that particular question to the naval authorities in view of the increasing difficulty of finding ships in which to train seamen.[1] Marines spend nearly half their service afloat, and while afloat occupy space available for seamen. Every hour they are kept afloat in sea-going ships longer than is necessary to attain efficiency, wastes corresponding space and opportunity of training seamen. Naval Officers demand sailing training ships in which to train young seamen, as they cannot be trained in ironclads. Before, however, the country can be brought to commission obsolete sailing ships in which to train men to fight modern mastless ironclads, it may wish to know why Marine Artillery and Marines should not man the mastless vessels, leaving the present sparred ship-of-war of a less advanced type to the seamen. Marine Artillery and Infantry who cannot go aloft are scattered over the globe in masted and heavily sparred ships, while naval Officers are complaining that "lads crowding" our latest ironclads who *can* go aloft are denied opportunities of doing so. One mastless ironclad chiefly manned by Marine Artillery and Infantry would, by disembarking and changing the men as fast as they became efficient, probably turn out more fully trained marine forces in a shorter time than a dozen sparred vessels under the existing system.[2] It is possible that the present use and application of marine forces is steadily deteriorating the seaman by keeping him in harbour hulks instead of at sea in sea-going ships. It is not impossible that under the existing system a large proportion of marines may have more actual sea service than the average of seamen. On this point there is no statistical information. As, however, of the 20,000 seamen 9,000 are not over twenty-one years of age, they could only have on an average about three or four years' sea service, while marines of twelve years' service would probably have six, about double the sea service of nearly every second seaman in the fleet. There can be no logical reason or justification for assuming that a seaman not over twenty-one years, and with only three years' sea-going service, is more fit to fight great guns afloat or Gatlings on shore, than the carefully instructed gunner of Marine Artillery thirty years of age who has had double the sea-going service, and besides six years' drill and instruction on shore. The naval system developed by the Royal Commission, intent upon arranging that marines shall "spend a large portion of their time afloat," may have

[1] Twelve years ago the late Commodore Goodenough pointed out, "We have not got enough ships to exercise and drill even the number of seamen we possess." *Vide* "Journal," vol. xv, page 492.

[2] "The marine is a soldier who passes half his service afloat and half on shore, and by that means when war breaks out we get men who are efficient at sea, and *in ships like the 'Devastation' we only require a few seamen to steer the ship, heave the lead, &c.*"—Admiral G. O. Willes, C.B., "Journal," vol. xix, page 614. The italics are mine.—[J. C. R. C.]

overlooked securing that seamen shall "spend a large portion of their time" at sea. This supposition cannot be regarded as baseless in the face of evidence of naval Officers competent to express opinions; for example, Rear-Admiral Sir M. Culme-Seymour has very recently stated as follows:—"I have been two and a-half years at Portsmouth, and, of course, thousands of certificates have passed through my hands. You would be surprised to see the little time out of the first five years that an ordinary seaman is at sea. It is hardly anything at all. There are numbers of ordinary able-bodied seamen at the home ports who, out of the first five years' service, never spend a year at sea."[1] Captain Noel, R.N., has also stated, "that young ordinary seamen have sometimes remained 'at Sheerness' for three or four years together."[2]

So much, then, for the past and present use and application of marine forces as regards chief features and relative results. Starting from a period when military Officers commanded professional naval Officers at sea, we have, by degrees, worked round to naval Officers commanding professional military Officers on shore. Curious indeed, would it be, if the expedient of a maritime regiment adopted over 200 years ago has produced in our own days many soldiers having more experience of the sea than half our seamen. Whether this be so or not, the history of the past and the present uses and applications of marine forces is the memorial of a Navy neglected by Parliament; of expedients substituted for a comprehensive naval system; and of a brilliant roll of services rendered to the Navy and the nation by generations of men, who, under the motto "*Per mare, per terram*," toiled in peace and fell in fight, unnoticed by the country they served so well. On no one flag could be inscribed the record of their services in war, and the melancholy distinction of their Officers is this —they did their duty uncheered by hope of personal reward, for naval interests barred their roads to fame.

Future.

It now remains to offer some brief speculations on the probable future use and application of these forces. The two centuries of their history have witnessed a stupendous change. The Island England of the seventeenth century is Imperial England now—but dependent on the sea for bread. Fitting it was that in the dawn of her Imperial day the colours of England's first maritime regiment should have displayed "the rays of the sun issuing from each angle," for now the rays of her civilizing light issue from each corner of the world. A Dominion in the West, an Empire in the East, an Australian brotherhood of young nations, a community of mixed races at the Cape, a host of possessions scattered about the world, a Suez Canal to be protected, and a possible Panama Canal to be watched, an aggregate Imperial revenue of some 160,000,000*l.* per annum ever increasing, though that of the United Kingdom stands still, and an Imperial sea commerce approaching in

[1] *Vide* "Journal," vol. xxvi, page 619.
[2] *Vide* "Journal," vol. xxvi, page 717.

value 1,000,000,000*l.* in each year, make up an aggregate of weakness open to attack, and sources of strength possible to defend only by combination. The cardinal principle of defence common to every portion of our Empire is the safety of the sea, and the most remarkable feature presented by our existing so-called Imperial preparations for war is this—that the necessity of combination for the defence of the sea is wholly ignored. In no sense is the Royal Navy Imperial. Some people who delight in high-sounding terms choose to call it so; their only excuse being that two naval cadetships are given to the Colonies in each year. India has an army; most of our great Colonies have local military forces; but with the exception of two or three, none have volunteer naval forces, and even these are simply for purposes of harbour defence. The burden of defending the sea is wholly borne by the United Kingdom, and therefore it is consistent with this fundamental anomaly that the whole naval structure, reared on such a basis, should be scamped. Our naval arrangements are in principle those of the Island England of the seventeenth century, and while an ancient sailing organization is endeavouring to squeeze itself into the modern steam fleet, the naval policy of an island is engaged in blowing itself out to imagine it has seeming Imperial proportions. Maritime war pressing on an Imperial sea-trade will, it is to be feared, teach us much we might have known before. For example, we may learn from bitter experience that absolute centralization of naval reserves and resources is not a sound principle on which to base preparations for world-wide sea warfare. That is the principle upon which we are acting, and which, I venture to believe, will fail us when it is put to the test. A belief in the absolute necessity for reversing that policy influences generally the conclusions which I am about to submit respecting the future use and application of marine forces.

In 1869 and 1871 I put before this Institution, in a series of four lectures, certain general principles of distribution and organization of our war forces,[1] and in those papers will be found, as regards the Army, theories, many of which are now accomplished facts; theories as regards the Navy, most of which are still theories—and chief of these latter was the absolute necessity for removing the Marine Artillery and Infantry from sea-going ships during peace and placing these forces while abroad at the British strategic ports. This paper is but supplemental to those which are now fourteen years old, and, therefore, those who wish for further information than time permits me now to give, will, I hope, find it in those papers. Evidence is not wanting to show the probability of this particular theory becoming a fact. Captain, now Admiral, J. C. Wilson some years later advocated removing marine forces from service as part complements in sea-going ships.[2] Captain Cyprian Bridge, R.N., in a very recent paper[3]

[1] "Distribution of War Forces," vol. xiii, No. LIII, and "General Principles of Naval and Military Organization," vol. xv, No. LXIV.

[2] "Seamen of the Fleet," &c., vol. xix, No. LXXXIII.

[3] "Suggestions for Improving the Efficiency of the Personnel of the Navy and its Reserves," vol. xxiv, No. CXVII.

writes as follows:—"The practice of sending marines to sea—in rigged cruizers—and keeping ordinary seamen in harbour, is absolutely indefensible. It is, for strong language here demands no excuse, intolerably mischievous and should be abolished. There is not a single compensating advantage however small." The question, therefore, to which I shall now limit my closing remarks, is this—what will be the use of marine forces, and to what purpose, and how are they to be applied when removed from rigged cruizers?

The use of marine forces will, I take it, be:—

1. To provide reserves of fighting men for the Navy in war.
2. To furnish the nucleus of trained artillery and the fighting force of infantry for armed merchant steamers.
3. To provide organized bodies of troops for the attack and defence of minor sea positions, free and untrammelled by a complicated army system, ill adapted to the military necessities of naval operations.
4. To furnish the nucleus for local Colonial forces, especially those garrisoning naval bases in our Colonies.

Under existing arrangements, if war overtakes us there would not be found on any foreign naval station a reserve of fighting men for our ships. Casualties in action or by sickness could not be filled up on the spot. Reserves both of ships and men are centralized at home, and war will bring the concentrated pressure of demands for both upon England, and England only, simultaneously from every part of the globe. My proposal was, and is, to break up this centralization both as regards ships and men, placing the marine forces on the naval stations, but not as part complements of the active force of sea-going ships in peace. The objection—that were this done the marine forces would cease to be efficient as sea-soldiers, and become simply Colonial troops—like the French Marines—requires brief examination. It can be met in this way—by training them in mastless ironclads before they go abroad, by sending them abroad in slow ships, by keeping them only, as now, three years abroad, and when abroad by embarking small drafts in rotation for sea training during a cruize in the ships on the station. Six ships, carrying six men each in rotation, for a three months' cruize, would provide three months' sea training for every 144 men in each year.

For fighting armed merchant steamers in war, the marine forces stand in the precise relative value and are as great an Imperial necessity as they were in the past history of the Royal Navy. Sir Donald Currie, M.P., has pointed out in this theatre this application of marine forces to secure fighting efficiency in merchant steamers in war.[1] On a former occasion[2] I gave reasons for surmising that patrol and intelligence duties along the lines of Imperial communication would, in war, have to be done by mail steamers following their ordinary avocations, but armed and having a trained fighting nucleus on board. If, therefore, the guns, fittings, &c., and Marine Artillery and Infantry, in due proportions, were distributed at the ports of strategic import-

[1] "Journal," vol. xxiv, No. CIV.
[2] "Naval Intelligence and Protection of Commerce in War."

ance abroad,[1] where these vsssels are perpetually calling in rotation, the equipment and men would have only to be shipped on the outbreak of war, and thus the great auxiliaries of modern naval power would be armed immediately and almost simultaneously all over the world. I propose, therefore, to throw the whole arrangement, at home and abroad, for arming, manning, and fighting the merchant steamers on the Officers and men of the Marine Artillery, the services of our scientific Officers and trained men of which force are now utterly unapplied if not wholly wasted. It is to be remembered this artillery service was created for the Navy, not for the Marines, and it is extraordinary that no steps whatever have been taken to apply it to general naval ordnance or torpedo duties, or to employ its Officers in naval Intelligence and Scientific Departments under either the Admiralty or War Office, or both.

It is hardly necessary to enlarge upon the necessity for Admirals having at their disposal a sufficiency of movable military force to seize and hold temporary positions during extended naval operations. The present army organization has excluded from view this naval requirement of our sea empire in war. Brigades, divisions, and corps d'armée, complete with field artillery and cavalry, are not suited to pouncing on an islet or sea position of an enemy in distant seas, and occupying it as a temporary coal depôt, or to seize and hold sea-girt rocks as ocean signal stations. The preliminary steps to using the Army thus, would be to break up its organization the moment war is declared. For this reason the marine forces are, in this respect, the sole remaining military prop of future maritime security on distant seas; but war-ships cannot be used as of old to carry them, and, therefore, their true place is at the Imperial strategic ports abroad, where transport is always obtainable, ready to swoop down in swift steamers at the bidding of Admirals to take or to occupy such positions as maritime war may require. The necessity of marine forces for this purpose, so far from diminishing has enormously increased, but the mode of application to their specific object must be of necessity different.

Since I advocated here and elsewhere[2] a redistribution of our war forces two events have tended to show the grave mistake of Admirals abroad having no movable military force at their disposal. Parliament rightly cheered, and the nation justly applauded Captain Bradshaw, R.N., for carrying off in the "Shah" purely military forces stationed at St. Helena to meet emergencies in South Africa. England was pleased to find a man with pluck enough to defy the distribution system she adopts and sharp enough to cut clean through the trammels of her own careful weaving. She praised the man and sticks to the system, trammels and all, for the Army, not marines, still garrisons St. Helena.

Again, had the Mediterranean Admiral had a reserve force of marines at Malta, as I ventured to propose in former lectures here, is it likely Alexandria would have been bombarded without first moving them

[1] "The Defence of Great and Greater Britain" explains the necessity for this arrangement, page 27.

[2] "The Protection of our Commerce," 1867.

up? And is it likely that with a couple of transports of marine forces under a marine General within signal distance of the flag-ship, Alexandria would have been burned and British subjects slaughtered for want of a sufficient landing force at the Admiral's disposal? Not merely old arguments and forgotten theories, but recent facts combine to draw marine forces out of sea-going ships towards commanding positions on our Imperial roads.

Their future use and application in relation to Colonial forces requires very special notice, and I regret it must be rough and brief.

A Royal Commission has been sitting to determine questions connected with the selection of Imperial strategic ports, coal depôts, &c.; to suggest an organized system of defence for such positions, and to say whether "such defence should consist of permanent works, manned by garrisons of Imperial or local troops, or both combined, or of any local naval organization, or other armaments and appliances." The Commissioners had to deal with broad principles, not, as I understand, with details as to the nature and constitution of forces to be employed. It was, I take it, without their province to examine beyond the local positions and local requirements of Imperial strategic ports. There is no impropriety, therefore, in connecting the influences and causes on which I have dwelt with the general heads indicated by their instructions.[1] Those influences and causes render it necessary to place marine forces at strategic ports to fulfil requirements wholly unconnected with their local defence. Whether, therefore, Imperial troops are or are not, in the opinion of the Commission, required for local defence, Imperial troops in the shape of marine forces should be there for other and more general purposes. But these forces are specially adapted to manning, or teaching local military organizations to man, "permanent works," and are specially fitted and trained to supply, or to teach local organizations to supply, the fighting power of such vessels as may be necessary for purposes of local defence. Consequently, at whatever conclusions the Commissioners arrive, the marine service stands ready to fill up the details necessary to give effect to whatever general principles are laid down as best suited to the defensive wants of any strategic port. The question of extending their use and application to this particular purpose is a simple question of numerical strength, not of constitution. At ports where the Commissioners consider port defence vessels necessary, these vessels so provided would furnish the means for keeping marine forces efficient as marines. For example, there are at this moment two turret-ships at Bombay; there are, at the same time, scattered over the East Indian station in sea-going ships, marine artillerymen, doing probably every duty but their legitimate one. These turret-ships could keep efficient as sea artillery more marine gunners in one year than the whole East Indian squadron will, under the existing system, in three. The symmetry of our Imperial naval arrangements may be judged by the fact that while the Marine Artillery and Infantry on the station are

[1] The full text of instructions will be found in "The Defence of Great and Greater Britain," Stanford.

excluding seamen from sea service, these turret-ships at Bombay are manned by land artillerymen. Again, at Melbourne there is the "Cerberus," maintained at the cost of Victoria. That vessel would in one year turn out and keep efficient as many Marine Artillery and Infantrymen as probably the whole Australian station would in six. Possibly she might thus provide a training school for an Imperial service at Colonial cost, and similarly those vessels at Bombay might provide two others at India's expense.

In our great Colonies in which ports of Imperial strategic importance are situated, the application of local forces largely to provide for their local defence is a foregone conclusion, because that is the assumption on which our whole Army policy now rests. But the history of English local forces in the past, and the current history of Colonial forces in the present, are full of warning. Even our metropolitan Militia regiments, within a stone's throw almost of the Horse Guards, were found to require a *nucleus of staff drawn from the regular Army, and constantly changing.* Why, then, can it be for one moment assumed that local Colonial military forces without such nucleus, and shut out from the sight of regular troops by half the world, can remain vigorous or sustain efficiency? Australian local forces would not now be without a single nucleus of regular troops but for obstacles presented by Army organization. Before British regiments were withdrawn, the Colonies offered to pay for a certain number of Officers and soldiers, but the number they thought they required fell short of a certain unit of military organization as it then was. The unit, it was said, could not be broken, so, rather than pay for a greater nucleus than they considered they wanted, they let all the troops go. Thus was an Imperial principle sacrificed to an Army detail.[1] Hardly, however, had the last soldier turned his back on Australia when, for divers and sundry causes, the obstructive unit was numerically reduced below the number for which Australia was willing to pay. While, therefore, the military efficiency of British local forces in the Pacific was weakened, the home tax-payer became chargeable with that proportion of Army expenses which Australia had offered to bear. The organization of marine forces presented no such obstacles to giving effect to the wants and wishes of young British communities.[2] It would be a matter of indifference to its system whether a corporal and two men were required as a nucleus for a local artillery corps at the tiny island of St. Kitts, or large drafts of artillery and infantry, with due proportions of Officers, non-commissioned officers, and men, were requisitioned for similar purposes by the great British continent of Australia. From Canada, not so long ago, came a suggestion that Marine Artillery should be sent as a nucleus for the local defence of Nanaimo, the only coal supply depôt of the North Pacific,[3] as the regular British force best suited to the purpose.

[1] See Australasian Parliamentary Papers, 1867 to 1871.
[2] See "Defence of Great and Greater Britain," page 240.
[3] "Report of Minister of Militia, Dominion of Canada."

As regards the element of cost in this future use and application of marine forces, until the Royal Commission reports, no estimate is possible, but one or two matters may be borne in mind.

Taking 6,000 or 7,000 of these troops out of sea-going ships involves filling their places with seamen. How many additional blue-jackets it would add to the present establishment cannot be stated until it is known how many seamen are being spoiled in harbour hulks. When they are cleared off to sea we shall know what extra numbers are necessary. But putting 6,000 or 7,000 marine forces at the strategic ports abroad means dispensing with the active services of 6,000 or 7,000 of the regular Army now isolated and stagnating for long years at outlying commands. The proposal, therefore, broadly means a reduction of the Army Estimates, and a corresponding increase of the Navy Estimates. There would be more seamen and fewer soldiers; the total national charge remaining much the same. Possibly it might mean an increase of the marine forces without an actual corresponding ratio of increase of burden on the United Kingdom. The marine forces while serving at the strategic ports of India would be an Indian charge. The expenses of those for certain Crown Colonies would be reduced by Colonial contributions towards the Naval Estimates on which the marine forces would still be borne. Possibly some of the great Colonies would willingly bear the cost of such Marine Artillery and Infantry Officers and men as they desired to employ as staff and as a nucleus for their local forces, and it is a question of important detail whether transport expenses might not be less for marine forces than for the Army. These are all matters for careful inquiry, which would be premature until the Royal Commission has reported and general principles of Imperial and local distributions are fixed.

I have now endeavoured to sketch the use of marine forces in the past, their abuse in application in the present, and their possible use and application in the future. Not merely are the arrangements for the maintenance of English naval power in a transition state, but sources from which that power naturally flows are shifting from England to her Colonies; changes suggested by the march of science in the internal constitution of her war Navy can only be arranged in the shadows projected over her own individual power by that aggregate of British agglomerations which she now calls her Empire. Empire in truth and in fact it is not now, nor will it be, until all British resources combined furnish the means to be applied to the united British purpose of defending in war—the sea. A real Empire it can never be if the policy prevails of trusting the future of an old country to provide for the ever-increasing naval wants of great and growing British communities, unceasingly engaged in piling up a sea trade such, even now, as the world has never seen before. The policy of leaving it to time to produce something, we know not what, has, up to this, only produced increased weakness in the British naval position, nothing more. These are the beacons and the rocks ahead of England now, and to steer for maritime safety we must strain our eyes over the bows and not be casting longing glances over the stern.

The "seaman" may have to give way to the "steam-man." The organization of the marine forces of to-day may be the foundation on which will be laid the naval organization of to-morrow. But these are small questions compared with the problem of absorption of the naval resources of Great and Greater Britain into one British sea force. The first step towards its solution is for England to realize the facts of Colonial growth; the next to prepare for change. The chief *non-political*[1] difficulty in practical arrangements is to find a common denominator which would make combinations of fractional war strength possible. That common denominator may be found in Her Majesty's Marine Artillery and Infantry. Possessing organizations suited alike to help small Colonial naval or military efforts, or to meet great Imperial naval wants by land or sea, the path of transition from one stage to the other would be smoothed for Colonial Governments by the presence of these forces. Thus posted at the British outposts overlooking the oceans, serving as troops on land yet ready to patrol the sea, there would be one force, one organization, one uniform example of invigorating strength, whether numerically great or small, unceasingly circulating in one continuous stream from heart to extremities, and back again in three or four years, the very life-blood of an Imperial system. The chain of outposts along the Imperial roads of the world would, under marine command, furnish as well the Imperial staff, and be the territorial depôt centres of instruction and organizing power on which would rest all local forces, and by which would be knit together in one common bond the war power of an Empire which has yet to come. Maritime power has its roots on land, and naval freedom relies on the military security of fixed positions, but military security does not ensure that the sea shall be free. The growth of Colonial trade is, in view of war, an increasing British danger which purely military efforts of our Colonies cannot avert. They, as well as the mother country, must prepare for change. From sympathy and common interest in that military force which serves on sea as well as on land, it would be but a glide for armed Colonial subjects of the Queen to follow its fortunes when war threatens their own trade, and beckons the marine forces to the oceans to serve, perhaps, in Colonial mail steamers for the protection of their own letters.

Canada and British South Africa, being exceptionally circumstanced, must rest for internal safety on an army system, but the war forces of all other Colonies, by being associated with the marine forces of England, would probably, from motives of economy and from sympathy, resulting from such association, gradually be drawn towards that regular service, and possibly might ultimately be affiliated with it, much as the local forces of the United Kingdom are now with the Royal Artillery and the Line.

And so, what marine forces have been to England in the past they may be to the British Empire of the future. They would at all events

[1] The great political difficulties I have pointed out in "Defence of Great and Greater Britain."—[J. C. R. C.]

bring to the task the accumulated results of two centuries of war and peace experience, and carry as their credentials to grander use and wider fields of application, their badge "The Globe," their watch-word "Gibraltar," and an inheritance passed on from generation to generation down to our own time, of duty—always done.

Lieut.-General LOWRY, C B.: Although I do not feel myself at all competent to enter with any minuteness of detail into the varied and very instructive paper we have just heard, I think I shall carry the audience with me when I say that paper has been at once thoroughly suggestive, forcible, and practical; and that it is of no small advantage to the country, and to the vast Empire of which it is composed, that a subject of such importance as that embraced in Captain Colomb's address this afternoon should be taken up and discussed by the Royal United Service Institution. I trust I shall have you with me, too, in this further remark—that it is well such large-sighted views as have to-day been opened out to us should not only go forth to our Colonies as tokens of the mother-land's abiding interest in them, but reverberate back again to this country the appreciation and reawakened interest and exertions for their own defence of the Colonies themselves. Time was, perhaps, when a lecture so fearless and outspoken might not have been looked upon very favourably by the authorities, but that time is past, and I believe this paper, and any such, will not only be welcomed, but gladly taken advantage of by those in office in the Army and Navy, and in the State in general. Let us hope, too, that ere long, men of the breadth of view, of research, and of resource of the author may be more directly made use of in some definite way by the State. Mr. Chairman, about twelve years ago, when commanding the troops in a garrison town in Ireland, I had an opportunity of daily witnessing what could be done by an Officer of the Royal Marine Artillery in training some 400 raw recruits, and it has ever since continued to me a matter of surprise and admiration with what marvellous power he moulded these young Irishmen in the narrow limits of militia training time into very fairly well-trained soldiers. Ladies and gentlemen, that Officer was Captain Colomb, and I need scarcely say, though we have but seldom met in the interval, I have followed his course—one of increasing knowledge and power—ever since with the deepest interest. And let me add that his is no infrequent instance of the more than ordinary capacity I have met, in my very limited experience, of Officers of the Royal Marine branch of the Service. I hope the subject developed in this paper may be thoroughly discussed, and that the suggestions put forward may reach all those lands which own our sway, and which naturally look to England for guidance and encouragement in the early development of their naval and military resources. I think Captain Colomb has admirably referred to the gallant corps to which he belongs—a corps often tried, and never found wanting—as "a common denominator," and it seems to me that no force could more fitly meet the necessities of the future in the matter of Imperial defence on the seas which margin our vast dependencies, and supply their and our needs, and in the harbours and coal depôts which equip them, than that of the Royal Marines. I am sure none could be better suited to do the work of training the volunteer naval and military forces of the Colonies, and that the more we develop that force in both its branches, and so employ it "*Per mare, per terram*" in time of peace, the better prepared will those so scattered but so vast dependencies be to stand by us and us by them in time of war. A paper such as this reminds us—and we need it—we have got to be prepared to compass in the day of danger the seas of the world.

Major BRIDGFORD: From this most interesting paper which the gallant Officer has just read, and which contains an immense mass of most valuable information, one is led to suppose that a marine is actually completely trained on shore, and that the artilleryman takes about three years to train, the infantryman somewhat less. Now, I think that the marine is not completed in his instruction until after he has been for at least one full turn of sea service on board ship. That carries with it an additional three years; then when he returns to the shore he requires a revision of his drills, and that carries it on to something like a total service of seven or seven and a half years. This, of course, adds to the expense and time occupied in

the production of really efficient marines, and if the corps is to be used in the way indicated in this paper it would necessitate a very large increase in the number of annual recruits, also a large increase of facilities for training them on board ship. Without the training on board ship I repeat I do not think the marine is complete. The great difficulty that we have in the Naval Service of sea training the ordinary seaman equally applies to the marines, and if you abate one jot of the marine's sea training my experience and observation lead me to believe that he will, I do not say exactly deteriorate, but will be less perfect than he is at present.

Major ALEXANDER MAN, 3rd Batt. Gordon Highlanders: I wish to say a few words with reference to a point just touched upon by Captain Colomb, viz., the use of our marines in cases of sudden emergency on far off stations. It has been my good fortune to once benefit very much by such a use of these forces; and, as it was rather an uncommon instance, I will, Sir, take the liberty of mentioning it.

About eight years ago I was sent on very short notice to Chinese Manchuria to organize a police force for the defence of our Treaty port there, which was threatened by the banditti with which the province was swarming. In fact, our trade was standing still in consequence. I accompanied Mr., now Sir Edward, Malet, and soon found that there was absolutely no nucleus to build a force up with. I was there; arms were there; money was there; and there was a splendid fine race to get men from. But I had no non-commissioned officers to assist in training the men when got so I turned round to think where I could look for help. To Hong Kong, naturally. If, however, I had written to the General there, who no doubt would have been most willing to have aided me, I could not, by any possibility, have had men before the ice came down and closed us in. The only thing, therefore, was to ask the Admiral—Admiral Ryder. He at once, without a moment's hesitation, sent me three of the Marine Artillery: one sergeant and two lance corporals. I think they came from my friend Captain Philip Colomb's ship, the "Audacious." They were with me for about eight months, and I must say that I never saw such fine fellows. From first to last they took in hand under my orders, assisted by but two other Europeans, a couple of hundred or so Chinese and Manchus, and they picked up their language as they went along.

It is not for me here to say what we did with our little force: suffice it, it kept the port free.

Captain CURTIS, R.N.: I think the nation at large cannot be too thankful to Captain Colomb for exposing the present position of our maritime forces. With respect to taking the marines from the ships, we had a specimen in the "Albion." When the "Albion" went in under the Wasp battery at Sebastopol many of her crew were taken out of her, and she was considered to be in a state of demoralization on account of the inefficiency of the Officers and crew. I think there is a great deal in what Captain Colomb said, with respect to the small craft specially—that all the men on board small vessels should be seamen. I think that if marines have been three years at sea they should have twenty-six drill days, at least, on a vessel like the "Royal Sovereign." Admiral Martin, in the Mediterranean, when we were lying off Naples, ordered all the ships to get under weigh once a week. We got under weigh on general quarters days early, and returned back to the anchorage in the evening, when possible. We thought nothing of it. I think, after breakfast, the ship's crew might go on board a floating battery, take her out to sea, go through their drill, and come back again, and by so doing become very proficient. At Vancouver and other Colonies we should have two or three vessels of that sort, and that is where the Colonies might help us by subscribing towards our Naval Estimates. I think it is rather too much for the mother country to provide all the protection, and the marines, at the latter end of their service, might be engaged by the Colonies; and if they went there with their wives and families, they would serve as a nucleus force for the purposes of their defence. I speak more especially of Vancouver, because we may look upon that island as the England of the Pacific; and from what we generally read it is usually considered that foreign nations would not attack our Navy. It would be our Mercantile Marine that they would attack, and also our outlying Colonies; and the more extensive our Colonies, the more our Navy is weakened, because we have the more to look after or guard. Captain Colomb spoke of sending the marines out

once a week in their own ship. In former times the marines were not seamen; they were a disciplined force to set an example to the seamen, and, I am ashamed to say, occasionally to keep them in order. For instance, it is absurd to imagine that Blake, however clever he might have been, was a practical seaman. No doubt he told his sailing master or Captain to get as close to their enemy as possible, and afterwards to board him. I have been often told that in 1808, the master of a 38-gun frigate about to engage a Turkish squadron, consisting of a frigate, 52 guns, and corvette 26 guns, asked the Captain whether he intended to board the vessels or not. The Captain said: "I do not intend to board him, and I do not intend him to board me." The Captain did not open his mouth to manœuvre the ship; he and the First Lieutenant directed the guns. The sailing master manœuvred the ship the whole time; put his ship as often as he could under the stern of the enemy's vessel, in order to give her his broadside. The corvette was supposed to have been sunk and the frigate was captured. That was in 1808. The main point is that after the marine has been three years at sea he may be well depended upon to take charge of floating batteries, to work the battery guns, and put out to sea, perhaps twenty-six days in the year, to keep the men proficient in their duties.

Commander W. Dawson, R.N.: I should have been glad if some Officer on the Active List had stated his opinion about taking marines out of a ship. Twelve or fourteen years ago I spoke very strongly in this Institution against taking marines out of a ship. I am not sure that circumstances have not so greatly changed since then that I am justified in altering the opinion I held in those days; but my opinions are not of much value, as I have not been afloat since then. Of course, what the naval Officers felt in those days very strongly was that the marines were a nucleus of discipline which would be useful not only in days of peace, but especially in time of maritime war, for when our Service becomes expanded to meet the exigencies of a great naval war, we shall be obliged to introduce into the Navy a number of untrained and undisciplined merchant seamen. That was a difficulty in doing away with the marines afloat which strongly impressed me in those days. Another point which I dwelt upon in that discussion was that naval Officers were deficient in knowledge of the details of discipline—deficient in capacity for giving effect to the chain of responsibility in the inferior ranks. I do not know what occurs now-a-days, but when I was afloat it was not unusual to see a Captain of the Navy, or a Commander, acting as a superior housemaid, and directing the operation of washing decks—a thing which the sergeant of marines would do on shore. There was no idea of a chain of responsibility—of putting the subordinate and petty officers in their proper places. I believe we have a good deal improved in all that, and that petty officers are trusted and held responsible for many subordinate duties, and I daresay it is possible that the marines might now be removed from the fleet without the heavy loss which we thought would accrue to discipline when I spoke in this theatre some twelve or fourteen years ago.[1] In other respects I think Captain Colomb has made out a very strong case for removing the marines from the ships, and sending them out in larger numbers in some of the mastless ironclads for the simple purpose of training. It is certainly a standing shame and scandal that we should have ordinary seamen going morally and physically from bad to worse in our ports, not able to get to sea, at the same time that we are sending marines to sea in ships. There are at Portsmouth and Devonport, and have been for many years, large bodies of ordinary seamen who cannot get ships to go to sea in, and those young men are contaminated morally and physically—not learning their profession in any way, and going altogether to the bad. Nothing can be worse than the naval system in that respect, and if Captain Colomb will show us

[1] I omitted to say what ought to be sufficiently obvious, that the sterling qualities of the Royal Marines, which have made them the admiration of successive generations of naval Officers, are not due to the source from whence they are recruited, but to the training and example of their Officers, whose invaluable services have received scant acknowledgment either from the Navy or from the Army.—W. D.

a way out of that, I think we ought to welcome any suggestion which will relieve us of that difficulty, and enable us to send these young men to sea, and get them into good sea training. Those are points upon which I should have liked to have heard some Officer on the Active List speak. There are several here present holding distinguished ranks in the Navy, and I am sure it would be good for the country that they should tell us openly what they really think about these points, because it is not a matter on which I can give any useful information, not having been afloat for many years; there has been very great moral and professional progress in the Navy in course of that time. The seamen at present are very different—physically, intellectually, and morally—from what they were when I went to sea; the system of naval discipline is not so imperfect, some general organization is beginning to exist, and, perhaps, Officers as a body are a little more enlightened and capable than they were, and know how to regulate the chain of responsibility, so that they do not put a Captain or Commander to wash the decks. All that may have altered, but one would like to hear from active Officers whether they agree with Captain Colomb's suggestion that the general organization of the Navy is yet such that the marines should be safely landed, and that the ships should be entrusted solely to seamen.

Vice-Admiral Boys: It is extremely difficult, especially for a naval Officer who has not been brought up to take part in debates, hearing a paper read for the first time of this description, to rise up and criticize it, and take it in detail. For my own part I am not competent to do it, though possibly if I had it for a week or so I might be able to find some fault and discuss it fairly. There is one point, however, which I will mention. Captain Colomb has made, to a certain extent, comparison between the education and training of a naval Officer and the marine artillery and marine Officer. Of course he has taken his own view of it, and has, as he is perfectly justified in doing, coloured it in favour of the artillery Officer. I do not think he is quite correct in the conclusion that he draws—especially when he refers to the ages of the Officers. I think he says, "The marine artillery Officer, age 20, must be the superior of the combatant naval Officer, of the same age, in general knowledge." He draws his conclusion from their reports "in scientific attainments and in practical artillery training." We will take the naval Officer of 20, and the marine artillery Officer of 20; and I would ask which of those two individuals would be preferred by an Admiral or Captain commissioning a ship as a fighting Officer for the naval Service? It is only natural that the naval Officer should be the one, because he has been undergoing a practical education in gunnery and different duties at sea, as an Officer in boats and in command of men in various ways. I will not go further into details. Captain Colomb has given us an excellently written paper with quite a poetical *finale*, and the whole paper is ful of suggestions; but there is one weak point in principle in it, and that is that he proposes that this "common denominator"—the marine Officer—should take the position of the naval Officers in instructing the seamen in various duties.

Captain Colomb: No.

Admiral Boys: If I am wrong I shall be happy to retract. That was my view of what was said, and in principle it would be a mistake.

Captain Colomb: Oh, certainly.

Admiral Boys: It is a mistake that Officers of one Service should take in hand the instruction and training of Officers of an entirely different Service. I have a great many friends in the marine artillery and the marines, and I look upon them as being as fine a body of Officers and men as can be found in the whole world. The training that the marine artillery Officer receives is a very superior one, and (I am only giving my own view on the question of marines) I must say that I think that we have now in our Navy really no place for the highly trained marine artillery Officer. In former days they might have been necessary, and they did a great deal in training seamen and Officers, who were more ignorant of special artillery duties than now. Now our naval gunnery Officers are specially trained for instructing. I can sympathize with the feeling of marine artillery Officers, that all their high training should not be wanted again in the Navy. While acknowledging again their superior qualifications, I would abolish the marine artillery, and would raise the standard of proficiency in gunnery somewhat; of light infantry I would only have

one corps. I would not have light infantry and artillery separate; but I would have one body of men, and revert to the glorious old name of the "Royal Marine." I do not think I can follow Captain Colomb any further. That is my own view of the case. I would not reduce the marines by one single man; but, on the contrary, I would increase them, for there is ample room for them in the Navy, and for our general defence.

General SCHOMBERG, R.M.A.: I hope I may be allowed to add a few words to the discussion, though I fear I shall be able to add very little to what I had the honour of stating, about fourteen years ago, in a lecture on this subject. I then said that the state of indecision in which the marine Service was existing was mischievous to the Navy and the Marines. That state of indecision still continues, with mischievous results to both Services. It is only three years ago that the marine artillery was threatened with destruction. Admiral Boys seems to regret that its destruction was not accomplished. In the Prize Essay of last year Captain Lindesay Brine stated that the marines are the chief reserve of the Navy; but in their present condition, and at their present strength, they are an utterly inadequate reserve. I believe I am stating the fact when I say that after the last detachment had sailed for Egypt last year, there were about 500 Marine Infantry and 100 Marine Artillery left in England, trained and available for embarkation; this was the strength of the chief reserve of the Navy. Admiral Boys seems to think that the Marine Artillery are utterly useless. I will ask him who are to be the gunnery instructors of the fifty armed merchant vessels that would have to be sent to sea in the first month of a great naval war? A struggle for the command of the sea is surely not an impossible event. The poorest countries in Europe are spending larger sums on single ships than we are, and one foreign Navy almost rivals our own in its number of heavy ships, so that a struggle for the sea is not impossible. Therefore there must be a trained and ready reserve for the Navy, and if the marines be not suited to the requirements of the modern Navy, abolish them at once, and give the Navy a reserve suited to its wants and requirements. A reserve the Navy must have, and a numerous reserve; not only a well trained reserve, but one adequate in numbers; and it is utterly inadequate at present. I believe the First Lord of the Admiralty said last year that the training of the Royal Marines left nothing to be desired. The Royal Marines were all very proud of the speech, and I must add a few words to it—that training is entirely the work of the hand and brain of marine Officers. But a perfectly trained reserve is useless unless it be sufficiently strong in numbers. I believe the only solution to this question is what is proposed by Captain Colomb, which I suggested fourteen years ago, and which Admiral John Wilson talked of eight or nine years ago, namely, that marines should form a very large portion of the colonial garrisons. Of course, if the marines are to occupy this position, they must be very much increased in number. There may be selfish interests to interfere with this; but if the marine be necessary for England selfish interests should be sacrificed. The question is, is he worth the sacrifice? and the sooner that is decided the better. In my opinion the marine service ought not to continue to exist as it is now constituted, because no State—not even a Venetian Republic—should retain Officers in its service whose future is doomed always to be perfectly hopeless.

Admiral BOYS: General Schomberg asked me a direct question. I think he is rather under a misapprehension. I did not intend to say abolish the marine corps. My intention was to amalgamate, not to abolish. And in reply to the question about instruction for the merchant ships, I say the crews would be seamen, and I do not see why they should not be trained by seamen Officers.

Major MOODY, R.M.L.I.: I should like to say a few words on the admirable and exhaustive paper we have just heard. I think it is an important point, although one of detail only, to settle how long a marine should serve afloat to become efficient, and how this service can be arranged. Provided the lecturer's propositions as to the future uses of marines are adopted, a large increase of the corps would be needed. To provide an adequate sea training without adding to the expenses of the fleet is to be considered. I take it about two years afloat is necessary on an average to make an efficient marine soldier, and to satisfy the sea-legs theory, which I consider a very important one. Without the sea training the force would simply become artillery

and infantry trained in naval gunnery, but without the self-reliance and adaptability which makes the marine forces so generally useful. Captain Colomb proposes to get this sea training by manning mastless ironclads with artillery and infantry marines, sending them out to their colonial duties in slow sailing-ships, and embarking men employed on colonial duties in the fleet on the station in rotation. This would no doubt provide training for a larger number, but I consider not sufficient in proportion to the general increase required. I propose that marines should be embarked when qualified as artificers and replace some of the large number of non-combatants now borne in sea-going ships, from 50 to 60 per cent. in some instances. A large number of artificers are enlisted in the marines incidently, many of whom are never utilized, and if it were known artificers were required I feel sure there would be no difficulty in getting sufficient candidates. Such men would be trained similarly as any other recruit, and be part and parcel of the marine detachment. The advantages of this system would be, first, a larger force of trained fighting men could be borne in sea-going ships, as the present artificers are entirely untrained to arms; second, room might be made for more of the blue-jackets proper, who are now kept in harbour ships; third, when any sudden increase of the fleet was required the marine artificer would be available for his legitimate duties, and artificers might then be entered from the shore as at present. From my experience of four years in command of 100 marine artificers employed in the dockyard and naval works of Bermuda, a system introduced by our Chairman, I believe, when Director of Admiralty Works, I found the work in no way interfered with their efficiency as soldiers. They were the smartest and best men I ever had under my orders. The only drill they had was two hours once a week at naval gunnery and one afternoon infantry. No more was required. I consider the more useful the corps is made, provided its splendid organization is preserved, the better it will be for the corps and the country. Few out of our Service have any idea of the many positions a marine during his service is called on to fill. The importance of training marines ready to supplement the scant crews and to supply the disciplined fighting force for armed merchant steamers is a point which cannot be too strongly urged. They are the only suitable men for the purpose, and should be available, as Captain Colomb has pointed out, at all stations where warlike gear for such steamers is provided; most of it might be placed under their charge. The most important point, however, introduced in the lecture is that suggesting the Marine Artillery and Marine Infantry should furnish the nucleus for local colonial defences. Too much weight cannot be attached to Captain Colomb's opinion on this subject. It is a question he has studied for many years, and is looked up to as an authority by the country. The marine forces are admirably adapted for this service, being accustomed to serve in small detachments all over the world, and so elastic is their organization, as he has pointed out, that it matters little the size or number of the detachments required, providing the numbers voted for the corps are sufficient, and the necessary amount of sea training is given. In this way the colonial portion of the Empire could be amply supplied with the nucleus of a fighting force with uniform discipline. If it is the case that the Colonies are losing touch with the mother country as far as warlike defences are concerned—different systems of discipline, and even arms, being introduced in different Colonies—the sooner such a state of affairs is remedied the better. It is simply courting an enemy's attack. Colonial service, in addition to their other duties, would be popular with the corps, as outlets could then be found for staff employment which the Horse Guards or War Office rarely give, and the want of which is so much felt in the corps. I am sorry no colonial gentleman has offered any remarks on this portion of Captain Colomb's lecture. I do not know men who are more suited to colonial life than the rank and file of the marine corps. The adaptability and self-reliance learned in their service afloat in early life adheres to them, and instead of these qualifications being wasted as at present in overcrowding the labour market in the neighbourhood of our seaports, it would be applied where it is required, and be appreciated in our vast colonial possessions all over the world. By allowing men to settle in the Colony where they may be serving on discharge, a valuable reserve would thus become available when required. I now pass to home defence. Considering the trouble and expense which is being taken to increase and foster the

Army Reserve, I cannot but think it is a matter of regret the services of the marines who have passed through the ranks are not utilized as a real naval reserve. Numbers of the corps, who by purchase, after twelve years, and invalids unfit for foreign service, &c., pass out annually, would only be too glad, for a small annual retaining fee, to join such a reserve were it organized, who are now lost as a body to the country. As a large number of these men reside within easy reach of the great naval seaports, there would be little difficulty in carrying out such a scheme. In conclusion, while thanking the large audience for the patience with which they have listened to my remarks, I consider the marine service is under a great obligation to Captain Colomb for his valuable paper, which must have taken so much care, time, and ability to draw up, and which he has come a long distance to read. It has drawn the largest audience I have seen in this Institution on one of the most inclement days we have had this year; an audience composed not only of numbers of representatives of the corps, but of other branches of the Service, and of civilians interested in the broad question of Imperial defence. As a serving Officer I also beg leave to tender our best thanks to the Chairman for the interest he has always shown in the welfare of the Royal Marines.

Captain BRIDGE, R.M.L.I.: Captain Colomb has alluded to a paper contributed to the Journal of this Institution by my brother, Captain Cyprian Bridge, R.N. In that paper he alludes to the employment of the marines for the colonial defence of our great Empire; but in the paper by my brother he apparently suggests that marines, when so employed, should be placed in very much the same position as they were the other day in the Island of Ascension, viz., under the Naval Discipline Act. I should like to ask Captain Colomb if he would tell us under which Act marines, if so employed in future, should be placed; and which would be most beneficial to national interests, and also to the employment of superior Officers of the Royal Marines. There is another question of the future, as to naval brigades. Captain F. Campbell, R.N., in a lecture delivered in this Institution last June, mentioned the position of marine Officers in naval brigades as more than anomalous; I should wish, as the employment of marine Officers and marines, in naval brigades, in the future is likely to be a question of everyday occurrence, if Captain Colomb would mind telling us what he thinks should be the position of marine Officers when so employed. He has told us here to-day the high training which the Officers of Marine Artillery and Light Infantry undergo, and also how well they have acquitted themselves as soldiers on all occasions, and if he would only enlighten us on the part that they should play when acting in conjunction with the Navy in naval brigades, I think some of us would be very glad to hear it. It is said that marine Officers cannot be employed on board ships of war in positions suitable to their acquirements, and that it is barely possible to make use of the talents and professional knowledge they possess when embarked; but when employed in land operations under the Naval Discipline Act, it would then be possible to place marine Officers in a position similar to what they would hold when acting in conjunction with the Army, and thus allow all ranks a chance of gaining the highest honours and rewards in their country's service.

Captain MACLEAR, R.N.: In confirmation of the suggestion by Captain Colomb as to forming depôts at foreign stations, I would mention that at nearly all our distant stations, the Pacific, Australia, China, and I think also the Indian stations, the ships are nearly always short of complement; and if this is the state of affairs in peace time, what will it be on a sudden call for war, when you require men not only to man the ships (and after the first action it may be assumed the ships will be still further short), but also to supply the requirements of arming merchant ships for defending the mail service and organizing naval brigades? It is certainly wrong that whilst our ships abroad are going short of men, young seamen should be deteriorating in our ports, unable to get experience at sea. This difficulty would be met by Captain Colomb's proposition to have depôts abroad.

The CHAIRMAN: Before calling upon Captain Colomb to reply to the various points that have been raised, I would venture to say, although perhaps few soldiers have been more in seagoing ships than myself, or have had to do with more Officers, both of the Navy and of the marines, from whom I have ever had kindness and support, yet into those questions touching any of the differences that

may arise on the relative relation between the seamen of the fleet and the marines of the fleet, I will not venture to express any opinion, although past experience may justify my holding an opinion of them. But I have a fair right to touch upon one question, and a very important one it is, which is shadowed forth in Captain Colomb's most valuable paper, and that is with reference to the future and extended employment of marines—I am perfectly indifferent whether they are called light infantry marines or artillery marines—but any body having the admirable organization, the admirable interior economy of the whole marine force—for colonial occupation and defence. This is not a new idea with myself, but I believe I can trace it back somewhere nearly twenty-five years ago, when the question of bringing away the regiments of the line from the various Colonies of the Empire was first started, and I think before a Committee of the House of Commons in 1858 or 1859, after I came back from Australia, I advocated the extension of the organization of the marines on some similar system to our Colonies as being the most efficient as it is the most economical system that the Empire could have adopted. The necessity for this has still more arisen in consequence of the new organization of our Army. In former years it was not unusual for a regiment of the line to go to a Colony and remain there 10, 15, or 20 years. Now, of the territorial system, of the short service system, I recognize the full advantages. Of course I know to a certain extent their weakness, but still to both systems I am myself an adherent; therefore I speak as an advocate of those systems when I say the introduction of the territorial system and short service into the regular Army in England, even had we no such organization as the marines—would necessitate our sooner or later creating that very organization, and I believe that instead of having a dark future for the marines as General Schomberg would lead us to believe, circumstances are now rapidly making it much more likely that there is a very good future for them on the extension of the same principles on which his grand old corps is formed. In our smaller Colonies, especially taking those Colonies most valuable to us, and at the same time most difficult for us to control and defend,—the whole of our Colonies to the Far East, reaching up to China,—I have always advocated and would advocate still, that the garrisons should be entirely marines. Regiments of the line, constituted as they are, are not the most effective agents now for colonial defence, and they are most expensive in those positions, requiring as they do large civil departmental corps to be attached to them to make them at all efficient. On the other hand, as Major Moody has just said, you can move the marines at twelve hours' notice, or less than that; without all the necessary departmental arrangements which are involved in moving a regiment of the line, you can remove them 10 or 20, or 500 or 1,000 miles, knowing that their organization is of such a character that wherever they may go they can take care of themselves. That in the defence of the Colonies is a point of great economic value. Their organization offers another very great justification for their being employed in such a way. An Admiral, knowing every place where they are, on difficulties arising, whether amongst a civil population or by the approach of an enemy's fleet, could at any moment reduce his other garrisons and increase his forces at the menaced point. In our separate commands correspondence must take place, the case must be proved, and valuable time is lost before you can move any portion of the regiments, especially in parts of the world I have just spoken of. If there was one homogeneous command over the marines stretching round the China Seas under one General or one Admiral, you would secure for the Empire a very efficient service, far more economical than the present one, and one which would especially meet the requirements of our colonial service. As we have exceeded our time, I will not detain you longer, except to say that to me, at the present moment, having the responsibility of advising the Government in reference to the question not only of the defence of our commercial ports in England, because I can see the application of this very question of the reserve of marines to assist in the organization of the defence of our commercial harbours as well as of our military harbours, but also in the question of the defence of our coaling stations abroad, I believe the marine organization offers a satisfactory solution of that question. This paper has come to me at a most opportune moment, and certainly, whatever may come of it, I shall always be grateful for having [illegible] at this time.

Captain COLOMB, in reply, said: I am sorry to say there is really little for me to reply to. Of course a lecturer in reading a paper before this Institution naturally takes one side, and I think if there is any good in him, or any good stuff in the paper, it ought to bring out the other side pretty strongly; with the exception of what Admiral Boys said on the subject, there has been no "other side" at all. I greatly regret it, because I think the main object of every man who takes upon himself to come forward and read a paper here upon subjects so important and vitally concerning the defences and the war expenditure of this country, should be to get at facts, and if a man is always writing and thinking, and turning up information, and then comes and reads a paper, and people are kind enough to listen to it, it is a process of education for himself and for the Services generally. It is most desirable that the other side should be stated clearly and strongly; and therefore I confess I am disappointed that none out of many distinguished naval Officers present have answered my arguments. I am grateful to General Lowry for saying what he did. He was kind enough to mention some matters connected with the training of Irish recruits in 1871, and I am very glad to acknowledge the fact that I should not have been so successful, under the difficulties we were in at the time, if it had not been for my marine artillery training, and also for the cordial assistance and support of General Lowry, who was then Colonel of the 47th Regiment, and commanding Officer of the troops at Limerick, and also for the co-operation and assistance which his regiment kindly gave me upon all occasions. With regard to remarks made by Major Bridgford, he says that marines are not manufactured on shore. I never said that a marine is, or can be manufactured on shore. What I say here is that he must be trained at sea, not by simply going out for a few days' cruize: what I pointed out was that a mastless ironclad could carry more marines than sparred ships, and by having its complement chiefly composed of marines and marine artillery, and by disembarking them as fast as they become efficient as marines, I think that process would turn out more artillery and infantry soldiers trained to sea service than the old process which he spoke about, and which I think has been evolved out of want of any real naval system in the past. With reference to Captain Dawson's remarks, I am entirely at one with him in what he says, but he rather suggested that a naval Officer individually did not understand the chain of discipline. I maintain that the naval Officer has suffered from the negligence of the country, in not giving the Navy opportunities of a system by which the naval Officer would understand what the chain of responsibility really consists of, and the only way in which the Navy could be worked really as an organized force, is by that very chain of responsibility which it now lacks. With regard to what Admiral Boys was kind enough to say, I am very sorry indeed if I did colour the educational process in any shape or form in favour of the marine artillery. It was not my intention to do so, and he has not pointed out specifically any error in my statement; but perhaps from want of clearness I may have appeared to confuse the matter. It was the primary education of the naval Officer as compared to the marine artillery Officer at the age of twenty, that I referred to. I pointed out that at the age a marine artillery Officer had finished his primary education, so as to become an effective Officer at the cost of the State, the naval Officer had not completed his, and in drawing that parallel, I intended to show the vast waste of national money and national power entailed in educating to a superior extent a body of scientific Officers, making them fit to direct land or sea artillery operations, and to go on board ironclad or other ships to perform naval gunnery duties, and then from the moment they do go on board they have nothing in the world to do. True some Officers have occasionally been put in possession of gunnery responsibility in a ship —many years ago I was, myself—and even now through courtesy, or the particular view of the Captain of a ship, a marine artillery Officer is sometimes called upon to do gunnery duties. For instance, one of the turrets of the "Inflexible" was fought by marine artillery, commanded by a marine artillery Officer at the bombardment of Alexandria, and I believe, most entirely to Captain Fisher's satisfaction. His position in this exercise of duty, for which the country had trained him, was due to Captain Fisher's courtesy; other Captains deny marine artillery Officers such positions, and there are no regulations for their artillery employment. I say that in these days, when it is so difficult to get money for war purposes, you have no business to

waste one penny, and I assert you are wasting thousands in creating marine artillery Officers whom you say you can't or won't employ. Admiral Boys is in favour of abolishing the Marine Artillery, because the Officers and men are too scientific and too highly trained. Well, if you have got such a superabundance of scientific training and artillery knowledge that you cannot really apply it to naval or general purposes, whether on board ships or on shore, to meet the naval wants of our huge sea Empire, I say if we are so teeming with knowledge, and with scientific power, then do away with the superabundance, and do away with the Marine Artillery. On the other hand I confess, that looking to what the war requirements of England would be, to the coast operations and the defence of trading lines, coast covering forces, blockading forces, torpedo duties, defence of mercantile ports at home and abroad, and the whole complication that is sure to arise in war, I think instead of having a superabundance of scientific and trained forces, we, on the contrary, are lamentably deficient, therefore I say that the misuse and waste of the Marine Artillery and Infantry is a great national question. It is not to be put off by praising the marines, and saying they are a splendid force, "a useful body of men," &c. We have no business to be complaining that the Naval Estimates are too small, while there is a force of nearly 3,000 artillerymen with Officers scientifically trained as they are, being wasted, which means waste of money also; therefore I agree distinctly, that if we have got a superabundance of highly trained forces, the Marine Artillery should be abolished; but I most absolutely deny that we have, for sea purposes, even a sufficiency of trained force. Looking at the rapid progress of the science of war on the sea, and the growth of our sea trade, we should be thankful we have a properly organized force of marine artillery, but we should not waste that force as we do, but should use it in the best possible way. Admiral Boys says there is no room or no work to do for marine Officers. I read a paper here some two years ago, on the necessity for naval intelligence for the protection of commerce in time of war, and I am happy to say that since that paper was read, there has been a Naval Intelligence Department formed.[1] In that paper I asked, "Why should marine artillery Officers be employed as professors at the Staff and Military Colleges, instructing military students in military art, while the Admiralty has to rely on the War Office for such topographical information as is necessary for naval operations on the enemy's sea-board?"[2] I do maintain that if there is no use for marine artillery or infantry Officers on board ships of war, yet there is plenty of scope for the employment of that class of Officer. By all means if you can get the perfect training, and the necessary knowledge in the naval Officer, so much the better; but it is difficult to do so, because he has so many things to learn. With regard to applying the marines, artillery and infantry, to provide the means necessary for fighting merchant steamers when armed, Admiral Boys said seamen ought to be instructed by naval Officers. I am entirely of his way of thinking, in so much that whenever seamen have to be taught as seamen, I think it must be by naval Officers. But I never raised the question of teaching seamen on board merchant ships. What I said was that these merchant ships required a fighting force, and as we all know, the crew of a merchant ship is cut down to as small a number as possible. The competition is so keen that they must cheesepare in order to make a profit: the result is that the actual crew of the merchant ship is only just barely sufficient to keep the ship going, and out of that crew you cannot get a sufficient number of seamen to be a fighting force, and when you have to deal practically with arrangements for one of these armed steamers, it is no use your sending an Officer on board to teach the men to fight the guns; because the men

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[1] "Naval Intelligence and Protection of Commerce in War." *Vide* "Journal," vol. XXV, No. CXII. See also the remarks of the First Lord of the Admiralty (Lord Northbrook), relative to that paper, at the Annual Meeting of the Royal United Service Institution, 1882.

[2] I asked that question in 1881. In 1882, when naval operations became necessary at Alexandria, it was completely justified by the dispatch of an Army Staff Officer to the assistance of the Admiral.—J. C. R. C.

have no time, you could not get a gun's crew, you could not get your stokers from the engines, and the men on watch below to come and learn the drill; you might get saloon servants, &c., but they are not seamen; therefore, when you talk of arming and manning merchant steamers, you must be prepared to put a ready made fighting force on board. I do not want to take any work out of the naval Officer's hands that the naval Officer can do, or the Navy provides for; but I do maintain that when you come to arm your merchant fleet, the very first thing will be that you will, unless my plans be adopted, have great difficulty in finding a sufficient number of fighting men diciplined and trained ready to go on board.

Admiral Boys: The naval reserve would be the first.

Captain Colomb: Quite so, if you can catch them: but where are you going to get them on short notice? Supposing you are going to arm 150 ships. You see war coming on, but those ships will go on running as usual to the last minute, and when war does break out you will find half of them abroad. If you have got your force scattered in ones and twos throughout your merchant fleets or bottled up at home, those ships will come home, and perhaps have to go out again, without any fighting force at all; therefore, to apply the principle of providing a fighting force for the merchant ships of this country as auxiliaries, you cannot base any assumption of efficient organization for that purpose which does not provide for the distribution of the force at all times on foreign stations where the merchant ships are continually calling. That being so, unless you have marines and marine artillery at various stations abroad, you cannot carry out that scheme. If you say it is a seaman's duty, then you must so far modify my sketch as to say that you must keep bodies of seamen on shore during peace at the stated points, if you are to simultaneously arm any proportion of your ships at any time. I have been asked, by Captain Bridge, a question as to what Discipline Act the marines should be placed under when serving on shore abroad, as I propose. My opinion is that they should serve under the Army Act, and that Officers trained for a specific purpose on a certain element are the Officers to command on that element. If you are going to place any body of marines in any position on shore, as I propose, to be used as soldiers, then, if the work is to be done efficiently and well, they must be under the Army Act, for the same reason that when Officers and men are put on board ship they certainly must be under the Naval Act. Captain Bridge also referred to Captain Campbell's lecture. I should like to read what Captain Campbell really did say. It was Captain Fletcher Campbell, R.N., who commanded so gallantly the Naval Brigade in Zululand. He says: "It seems to me not only unjust but inadvisable that an Officer in the Royal Marines when on shore should take command after a naval Officer who may be, and very probably is, very much younger and less experienced." I think it stands to reason that an Officer trained for shore operations is really, as far as possible, the proper Officer to command the landing force.[1] I wish to say, although the garrisons placed at the strategical points and outlying positions should unquestionably maintain their marine discipline while on shore and be under the Army Act, and commanded entirely by their own Officers, the whole force, with regard to its application when away from such positions, must be under the general control of the Admiral. The marine Officer, whoever he may be, in command of the station, would be the immediate and responsible commanding Officer of all these troops when serving on shore. When the Admiral requires a point to be seized, or a force to be moved, or any military work to be done, of course

[1] Were marine forces placed at the headquarters of each naval station, the Admiral would always have available marine Officers of rank and experience to take command in landing operations. Under existing arrangements, the senior marine Officer in a fleet or squadron must always be junior to all Captains and Commanders, even were the regulations referred to by Captain Fletcher Campbell altered, and therefore the extraordinary anomaly of naval Officers without experience of land operations commanding marine Officers who have both knowledge and experience of such duties would not be remedied, even were Captain Fletcher Campbell's views practically embodied in new regulations.—J. C. R. C.

he would give his orders in the same way as the Admiralty and the Horse Guards work together at home. Details should, I think, be left to the marine Officer entirely. I will, in conclusion, thank you, Sir, for having so kindly taken the chair to-day.

The CHAIRMAN: It is my pleasing duty to ask you to direct me to convey the expression of your thanks to Captain Colomb for his most interesting, and, I believe, most valuable paper.

Friday, February 9, 1883.

ADMIRAL SIR ASTLEY COOPER KEY, G.C.B., F.R.S., Lord of the Admiralty, in the Chair.

BATTLE SHIPS—A FORECAST.

By NATHANIEL BARNABY, Esq., C.B., Director of Naval Construction, Admiralty.

The CHAIRMAN: I am sure Mr. Barnaby does not require any introduction from me. You are all aware that in listening to him on the subject of "battle-ships," you are listening to the highest authority in England, I may say in Europe.

Mr. BARNABY: Before I make any remarks on battle ships, which form the subject of this paper, I should like to define the position which I think they occupy in the naval resources of the Empire.

The power of waging war on the seas depends, I consider, upon the following elements stated in their relative order of importance:—

1. The quality and extent of the mercantile marine in ships and men, provided that the national tie in both is real and firm.
2. The quality and strength of the trained *personnel* in the State Navy.
3. The ability to produce or procure rapidly and continuously material of war for the use of the State.
4. The number and efficiency of the regular ships-of-war possessed by the State on the outbreak of war.

Battle ships form a part of the last-named element.

There has been much controversy concerning the distribution of their armour; the size, number, and mode of mounting the guns; their speed, and coal endurance, and other matters.

But these questions all resolve themselves into one of size of ship. Armour, guns, speed, and fuel all demand as much as can be conceded to them; and the limit to each is finally imposed by the size or displacement of the ship. The controversy has taken form and shape in Italy in more imposing proportions than it has in England or France, and it has fastened itself on the question of absolute size.

Signor Brin, the Director of Material, and ex-Minister of Marine in Italy, is responsible for the designs of the largest battle ships she has produced and is now producing. In a very able pamphlet on the question he says, comparing single ships of great power with a group of ships of less power, that the case stands as follows:—

"The slower group cannot overtake the single faster ship, and she can always be mistress of the situation and maintain herself in the front, in the rear, and on the flank of the group at whatever distance she pleases, by changing these positions, by approaching nearer or drawing away from the group in order to attack one of the vessels."

By combining greater defensive "and offensive powers she can employ with greater precautions for herself, and with greater probability of success, the terrible torpedo."

He says further: "There is an old rule in military strategy, which, nevertheless, is always new, since it has never been belied by facts or experience; and it is the rule of concentrating successively, first of all on one point, and then on another, the greatest possible amount of force. Following this rule, we have seen small armies successful against large ones. In order to carry it out rapidity of movement is indispensable. But in what way would it be possible to put this rule more effectually into practice than by accumulating in the smallest space, in one very fast ship, such fighting and such defensive power as to enable her without hesitation to seize on the weak points of the enemy with the probability of success?"

In this paper I neither adopt nor challenge these arguments.

I am content to say here that with increase in speed and size the ship not only increases in mass, signifying greater energy in striking at given speeds, and greater resistance to injury when struck, but it becomes more easy to secure speed and endurance.

And not only so, but England possesses exceptional advantages in forging such weapons, and within the limits imposed by sizes of docks and shoaling of water it is conceivable that she might furnish herself with ships far more powerful than any which have been yet seen.

Diagram.—Battle Ships of European Powers.

The cost of individual ships must always be an important consideration, and it is especially so with a Power having extended Empire, requiring her to be present in force at the same time at many remote parts of her dominion.

It is a consideration, however, which must not be pressed too far, because the possession of ships which the financial limitation precludes might enable her to close a war rapidly, by blows at the heart of the adversary. In this way war at the remote parts of the Empire might be avoided, or terminated very quickly.

Constantly improving modes and means of attack upon ships by ships, and from the shore, threaten to change the character of the battle ship; and it is uncertainty in this respect which emphasizes the financial limitation. The recent operations at Alexandria show that for certain portions of the work the Navy is called on to perform the ships designed twenty years ago are still efficient. But the absence of torpedo-boats, and the neglect of torpedo defence on the part of the Egyptians, count for so much in this question, that the argument derived from success in that operation in favour of the earlier and also of modern types of battle ships is not worth much.

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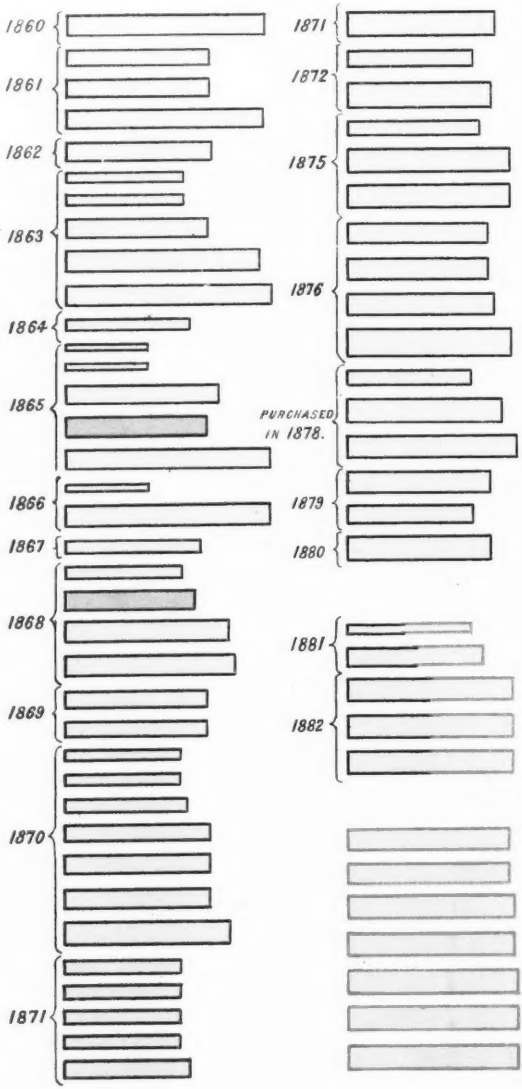
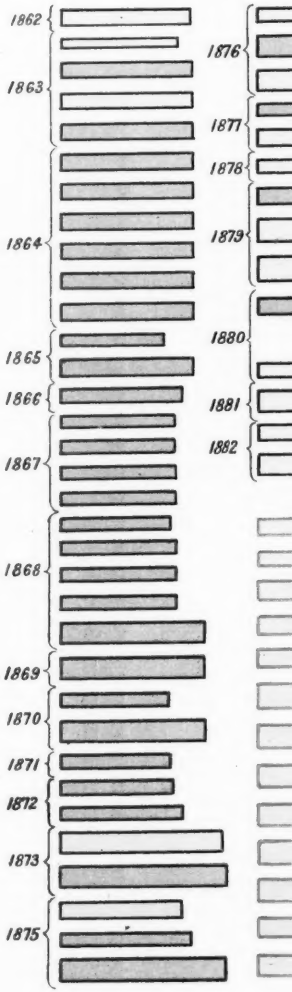
BATTLE SH

ENGLAND.



FRANCE.



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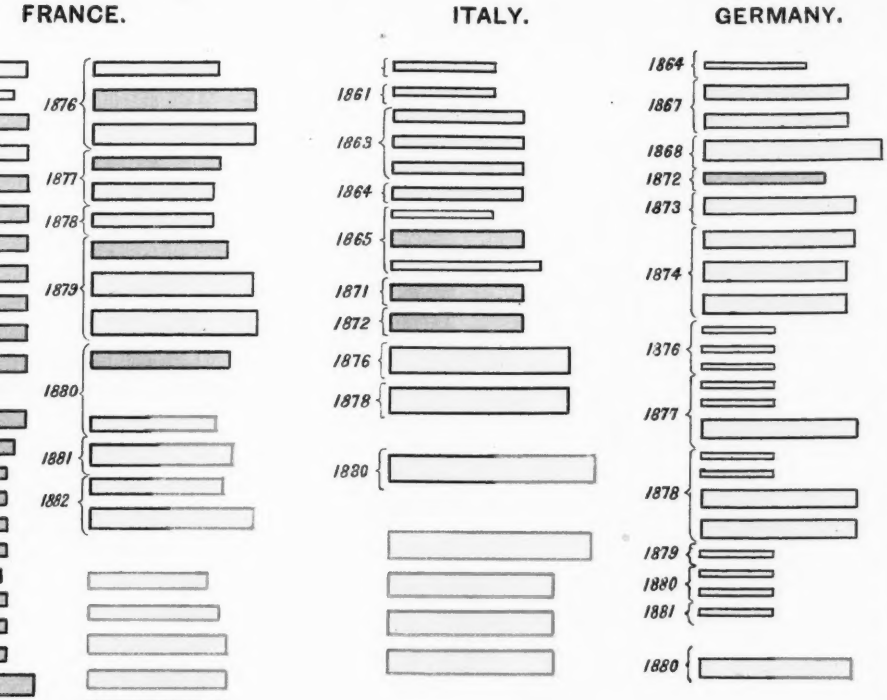

REFERENCES.

Ships now available.

Ships launched and completing.

Ships not launched.

Blue colour—Iron and steel ships.

Brown colour—Ships built of wood.

Dates are those of launching.

The length of each block is proportional to the length, and the area to the displacement of the ship it represents,

Sons, Lith. 3 Martins Lane, W.C.

12 INCH. 43 TON. B.L. GUN.

Scale, $\frac{1}{8}$ inch = 1 foot.

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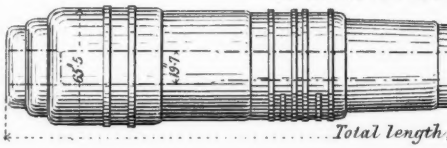
Approximate Maximum Powder Charge

Projectile

17 INCH. 100 TON

Approximate Maximum Powder Charge



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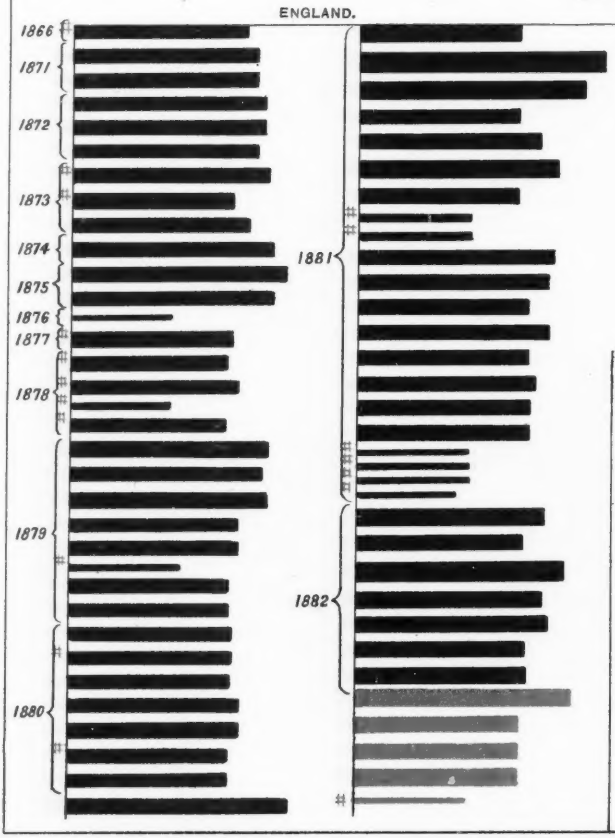

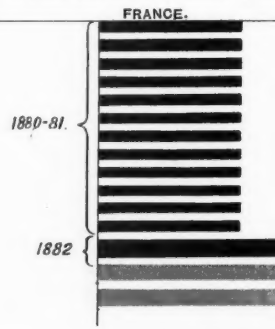

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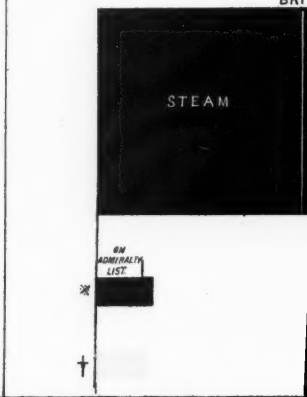

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16 INCH, 80 TON.-M.L-GUN.

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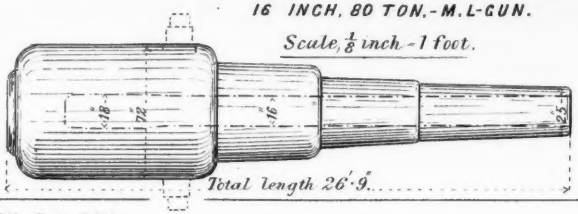

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Projectile.

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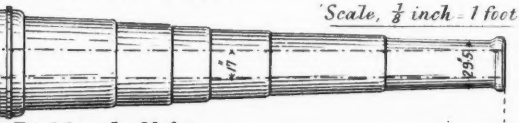
Scale, $\frac{1}{8}$ inch = 1 foot.



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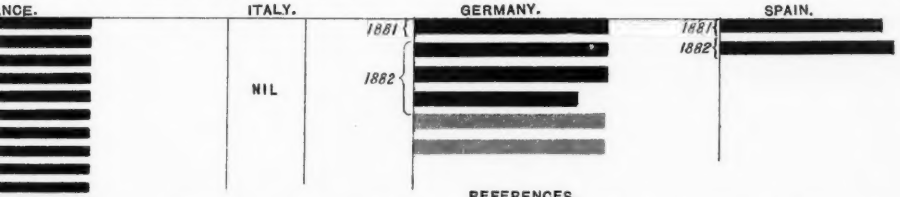
Projectile

14 KNOTS AND UPWARDS, MOST OF WHICH COULD MAINTAIN THE SPEED FOR LONG PERIODS

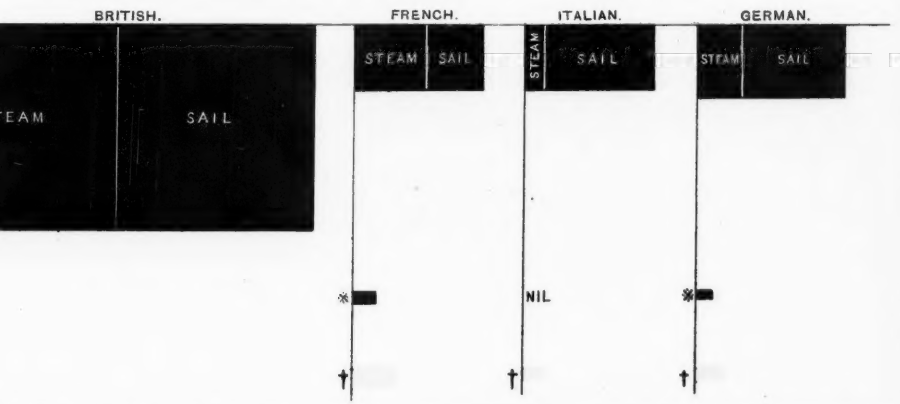
Steamers of the world are represented here.



REFERENCES.

The black blocks represent ships built. The red blocks represent ships building.
The length of each block is proportional to the length of the ship it represents, and the area indicates the displacement.
The figures given are the launching dates.
*All the ships shewn in the English columns, except those marked with an asterisk * have been qualified for "the Admiralty List."*

R BLOCKS REPRESENT THE AGGREGATE DISPLACEMENT TONNAGES OF THE MERCANTILE MARINE OF THE SEVERAL NATIONS.
HEW DISPLACEMENT TONNAGE OF MERCHANT STEAMERS HAVING SPEEDS OF 14 KNOTS AND UPWARDS.
HEW DISPLACEMENT TONNAGE OF COMPLETED ARMOUR-CLADS.



Sons, Lith. St Martins Lane W.C.

We may perhaps get some clearer notion as to what the battle ship should be for England, if we consider more closely what it will be required to do.

1. It must be capable of striking very destructive blows where the enemy is fortified, either in his ships on the open waters, or in his forts upon the sea-coast.

2. The machinery for striking these blows must be capable of being kept in position in the face of an enemy in the open sea, or off a port.

3. The use of torpedo-boats of high speed and in great numbers tends to the gradual extinction of the power of attacking or blockading the sea forts of an enemy by means of large ships, because of their great cost and the risk of fatal blows from the torpedo.

4. The advantage of being able to inflict damage upon the shipping which may be under the protection of land fortifications, or to close the port, will also be so great that the mode of attack must modify itself to suit the change in conditions. There can be no doubt, I think, that gun-vessels with numerous long-range shell guns, and costing not more than one-fourth of the modern battle ship, will displace the battle ship *for this service*, notwithstanding the disadvantages of the smaller ships in unsteadiness of platform and inferior seaworthiness.[1]

The battle ship of large size is not only likely to become obsolete for the attack and blockade of ports, but also for another important service, viz., harassing the commerce of an enemy.

This results from the great speed and coal endurance of the large ocean steamers.[2] Armed ships of the same character as those to be captured will probably be the favourite weapons for inflicting damage upon commerce.

These ships are now nearly twice as long as the ship-of-war of the same weight, and they can, therefore, much more easily secure and maintain a high rate of speed at sea.

I consider it would be most impolitic to build regular ships-of-war on similar principles for the purpose of pursuing and engaging them. The 17 knots ocean speed of to-day may be exceeded by commercial rivalries in the course of a very few years. It is desirable that this should be so; and instead of attempting to produce fleets of regular ships-of-war as a consequence of the existence of these fast possible war cruizers, we should endeavour to modify them and incorporate them in our national defences.

That they need very considerable modification to make them reasonably secure against the assaults of an enemy by artillery or ram is obvious enough.

But too much importance must not be attached to cases of rapid foundering on collision. Ships having many "watertight bulkheads" and passing the survey of Lloyd's and of the Board of Trade are often

[1] It would follow from this that ports which can be defended by torpedo-boats will not require for their fixed defences very heavy guns or very thick armour.

[2] Diagrams of Mercantile Marine, and of the fast ships included therein.

so circumstanced as to bulkheads that they may as well be without them so far as they affect the question of foundering when they are struck by the bow of another ship.

We may well look for great improvement in this respect by very simple precautions not now enforced or adopted.[1]

The Secretary of the Navy of the United States in his Annual Report to Congress, dated November 29th, 1882, dwells at great length on the position and prospects of the Mercantile Marine from the point of view of the Naval Administrator.

He says: "As the merchant marine is dependent at critical periods upon the Navy, so, on the other hand, the Navy, no matter how strong it may be, must, in emergencies, avail itself of the resources of the merchant marine."

At the outbreak of the rebellion the State Navy had nominally a tonnage of 105,000 tons. To increase it they had to buy 216,000 tons, which they found very "ill-suited for war purposes, but none the less indispensable." They had also to make additions to the Officers and men of the war Navy by drawing from the Mercantile Marine 7,500 Officers and over 40,000 seamen. He shows that between 1860 and 1865 the percentage of the foreign carrying trade of the United States performed by American vessels dropped from $66\frac{1}{3}$ to $27\frac{3}{4}$, and since then has fallen steadily, so that it is now only $15\frac{1}{2}$ per cent. He demands for the shipping trade the removal of impositions which he thinks unfair, the extension of protective measures to the neglected industry, and the reform of administration. He apparently does not like to propose the abolition of the protective measures which make shipbuilding materials so dear.[2]

Referring to the French Bounty System of January, 1881, and the recommendation of a similar system by Prince Bismarck to the German Parliament in 1881, he recommends a system of postal subsidies, involving the condition that such ships should be built according to Governmental requirements, and be subject to be taken for national use in time of war. He gives us credit for having such conditions in our postal contracts, but in that he is mistaken. Our postal subsidies have reference exclusively to postal requirements.

[1] Facts as to losses of ocean steamers said to be divided into watertight compartments:—

The number of British ocean-going steamships of an average ocean speed of 11 knots and upwards lost at sea since December, 1876, has been thirty-six, or at the rate of six per annum.

Of these, thirty had been offered for the Admiralty List, but only four were found to be reasonably divided into compartments, and accepted for the List. The total displacement tonnage of the thirty-six ships was 160,000 tons, and of the four ships accepted 16,000 tons.

Of the thirty-two ships not on the List, ten are known to have been lost by collision, and six by springing a leak. Four of them were lost from unknown causes.

Of the four ships lost which had been accepted for the List, all were lost by going ashore. They were the "Tasmanian," in 1878; the "Illimauni," in 1879; the "Arklow," in 1880; and the "Wicklow," in 1882.

[2] The action of the American House of Representatives in proposing a "Free Ship" Clause in the Shipping Relief Bill had not been taken when this was written.

One need hardly say, for it is obvious, that every trading ship possessed by a State is an advantage to the whole world, because it is an additional guarantee given for peace.

Operations on or in the neighbourhood of an enemy's ports, and attacks upon his commerce, are the two most important fields of maritime warfare. Fleet actions have hitherto grown out of them; and it is reasonable to expect that they will do so in future, and that the ships best adapted for these two fields of warfare will always be found in contending fleets.

The presence among the lighter ships of some ships with steady platforms, exceptionally heavy guns, and those guns defended by armour, would of course be a great advantage; and this may possibly become the sole function of what we now call the battle ship.

For this purpose neither exceptionally high speed nor great handiness would be regarded as so important as they now are held to be. They would need to have the average speed of the smaller ships of the squadron, and no more. What they would especially require would be heavier guns than can be mounted and worked at sea in the small vessels, steady platforms for working them, and good protection.

The guns that can be mounted and worked at sea with advantage in vessels of very moderate size may be of considerable power.

Their weight and power will be limited by the following considerations:—

1. As they are unprotected by armour against even the lightest shell, and as the ship carrying them would hardly be suitable for the service at all if less than about 2,000 tons displacement, there must be at least two such guns in each ship. In other words, the ship will be too large and costly to justify dependence upon a single gun so greatly exposed to fatal injury in itself, its mountings, and its communications with its magazines.

2. The vulnerability of the ship itself will keep down its size to a minimum; and it will almost certainly take the shape of a vessel of 2,000 to 3,500 tons, with a protecting deck, high speed, and two guns mounted in the middle line, one firing ahead and the other astern. It will therefore be necessary to place the guns as far out of the centre of the ship as possible consistently with seaworthiness, inasmuch as the spar deck spaces before and abaft them must be of the nature of a glacis, and be uninhabitable.

3. With this limited number of guns it will be desirable not to have a very slow fire from each gun. The introduction of machinery for the purpose of quickening the operation would be perilous, seeing that it cannot be protected. These considerations will tend to keep down the size of the guns, and they will probably not exceed a weight of 25 to 30 tons each. But it may be anticipated that guns of this weight will be found in this class of small and fast protected seagoing ships.

This justifies the expectation that the protected battle ship proper will require guns of larger size and power than 30 tons, so long as such larger guns are found to have advantages.

These guns may possibly have large calibre. Excepting the guns

of the "Inflexible," the largest gun yet constructed for the British Navy has 12 inches bore, and a weight of 43 tons. The ships recently commenced will have larger guns, probably 63 tons in weight, or heavier.

Diagrams of 100 ton B.L. "Italia."
" 43 " B.L. "Collingwood."[1]
" 80 " M.L. "Inflexible."

Experiments against steel and steel-faced armour have shown that we have at present no material out of which to forge or cast a projectile which will act at the same time efficiently as a punch and a shell. And even if we give up the attempt to make the shell, we have not yet found a way to punch a hole through the plates as we could through iron. We have to break a way through, and small diameter of projectile and small mass, with high velocity, are not favourable to this.

Large diameter gives mass, strength of form in the projectile, and favours the conversion of the projectile into a destructive mine for use against the unarmoured parts of the ships attacked, and against the walls of barbettes.

England has been successful in producing guns of 16 inches and 17 inches bore. And she has also done what no other nation has yet effected; viz., she has mounted such guns in a manner which brings them under perfect control by very simple mechanism.

The skill of the firm of Sir William Armstrong and Co., which has produced this mounting from the designs of Mr. George Rendel, is only an example of the mechanical power in design and execution which may be trusted to place in English battle ships weapons of power which other people cannot exceed. I have never pleaded for large and costly ships, but I have always agreed with those who hold that England should put into the hands of her seamen the most powerful guns which can be made and worked. In this way she ought to make her manufacturing skill tell in her favour. One reason why some other Powers do not adopt large guns may be that their own engineers find difficulties in mounting and working them.

As to armour, I ventured to say in 1876 that I thought the thickness of armour in the "Inflexible" was not likely to be exceeded. I am still of that opinion. I do not believe that increasing the calibre and weight of the gun will tend to thicken armour.

The result will, I believe, be that armour will finally nearly or quite disappear as side plating for the hull of the ship, and that where it must continue to be used for the protection of the gun and its mounting it will improve in quality, so as to be impenetrable to shell, however made. The principal projectile must be shell, and we shall probably find our-

[1]

Tons.	Powder, lbs.	Projectile, lbs.	Energy, foot tons.
43	400	714	20 000
80	450	1,700	30,000
100	770	2,000	46,0000

The 100-ton B.L. gun is 39 feet long. The projected 63-ton Woolwich gun is already considerably longer, and is probably growing.

selves with steel defences of excellent quality, but of very limited extent, over our gun mountings; and the smallness of their size and their impenetrability to shell will practically leave them unassailed, while the upper works of the ship, above the shot-proof deck or belt, are attacked by shell.

Reluctance to introduce large guns would, I believe, only delay this process of change.

I have not touched upon those other reasons for advocating the association of small and fast protected but unarmoured vessels with battle ships which arise out of a consideration of the exigencies of the purely naval fight upon the high seas.

A thoughtful paper was read on that subject at this Institution by Captain Harris last year, and the Chairman then referred to the great debate on the question in the Institution of Naval Architects in 1876, and to a subsequent paper of mine of 1880.

What I have tried to do in this paper is to strengthen the argument in that direction, by considering more particularly how two well defined naval operations, the attack upon ports and the protection of commerce, have in their changed conditions affected the question of the character of the battle ship.

The questions raised in this paper which seem to be debateable are,—

1. Should England build ships greatly exceeding in speed, coal endurance, guns, and armour existing ships of the first class, regardless of size and consequent cost?

2. Will not the enemy's ports require to be attacked and blockaded, notwithstanding the torpedo? and if so, what description of ship will be suited for this attack?

3. Ought regular ships-of-war to be built of sufficient power and speed to capture ships like the "Servia" and "Alaska" and their larger and faster successors? or should we not rather look to the services of such ships for the work, endeavouring to fit them for it?

4. When the powers of the ram and the torpedo come to be tested in actual warfare between two Great Powers, what part may we expect to be assigned to the fast gun and torpedo ship with protecting deck, and the merchant auxiliary, as a result of these contests?

5. Ought the battle ship of the first class to carry guns of the largest calibre which can be made and worked? or should we be content to allow the gun to progress slowly with the advance of the armour?

I have wished in this paper to guard myself against the advocacy of a particular policy with regard to any of these questions. It is my duty to observe tendencies carefully, and as no discussion on such subjects can be profitable which does not take the elements tending to change of conditions into account, I have submitted them to you. When travelling along a badly defined road in an unknown and difficult country, we may avoid errors and delays by getting on high ground, overlooking the minor features of the road along which we are passing.

Vice-Admiral Boys: I should like to make a few remarks upon this paper,

although I must confess that I do so with some diffidence, for he must be a bold man who ventures to attack Mr. Barnaby on such a subject as he has taken up to-day. The first question I would ask is, what is the real meaning of the term "battle ship?" because I do not see that it is laid down in any classification of Her Majesty's ships. We all surmise what it practically means: it means a ship to take the place of what used to be the old line-of-battle ship; but still at present we do not know where the battle ship ends, and where the frigate or whatever comes next to her begins; we have no definition of it, if it could be defined, we should be a little clearer. Mr. Barnaby begins by saying, "The power of waging war on the seas depends, I consider, upon the following elements stated in their relative order of importance." Of course, this means the successful waging of war. No doubt these are all elements, but in my view of the case he has not exactly placed them in their relative order of importance. I should be very much inclined to "reverse the line from van to rear" altogether. I think the first element is the number of efficient regular ships of war possessed by the State on the outbreak of war. The early success of a war will probably be the most important during the whole war, and it is quite possible that ships and fleets may be blocked up in harbours by the first blow that can be delivered. For that reason I place that element first. Next to that I place "the quality and strength of the trained *personnel* in the State Navy." "The quality and extent of the Mercantile Marine in ships and men, provided that the national tie is both real and firm," is a very important element. There is another that I should like to add, namely, the proficiency of the Officers and men to fight these ships, and that is a most important element in war that must be provided for in peace time. Lastly, comes the aptitude of the nation for seafaring pursuits from which we have to provide the reserves. On the question of Signor Brin's pamphlet, I am generally in accord with what he says. I think he has given us a fair description of the right qualifications of first-class battle ships. I consider Italy to have been perfectly right in what she has done. She has got rid of her old obsolete ships, and expended all her money in procuring the largest and most powerful ships in the world. Certainly, she is peculiarly circumstanced. She has her own sea-coast only to protect; her ships will not be required to go far from home, and, on one point, she has a great advantage over us, because the coal endurance of the ships is not so much a necessity for her as it is for us. The diagrams are most clear and instructive. I have learned immensely from them, and I must confess I have often before this learned much from Mr. Barnaby. The next point is the cost of individual ships as an important consideration. It is made an important consideration with us, but in my view of the case it ought not to be made an important consideration at all. Consider what we have at stake, our food supply—the very existence of our homes—depends upon the efficiency of our Navy, and I am sure the country, and the British taxpayer, if he only knew and would only consider the question, would not hesitate to make great sacrifice to provide for every necessary expenditure to meet its requirements. I may here refer to a letter published the other day by Sir Edward Reed, in which he puts the case very fairly as to the necessity of spending more money upon the Navy. I am not a politician, but I think every Government of late years has been hampered by the necessity of reducing Naval Estimates; and, consequently, we have not got that efficiency either in quality or number in our ships that we might have had, had more money been devoted to the Navy. Sir Edward Reed alluded to half pay and pensions; that has little bearing upon this question of battle ships, but I think the country would not even object to the money spent in that way, for what is to become of us when we become old fellows? Are we all supposed to go into the workhouse? We must have something to live upon. Mr. Barnaby in referring to the use of torpedoes says: "The use of torpedo-boats of high speed and in great numbers tends to the gradual extinction of the power of attacking or blockading the seaports of an enemy by means of large ships, because of their great cost and the risk of fatal blows from the torpedo." I do not quite see how this paragraph is intended to apply in connection with battle ships, because if we are not to attack forts owing to risk, surely we had better not fight at all. No fighting can be undertaken without risk, and I think in the matter of torpedoes there is much uncertainty. No doubt the effect of them is most formidable if they succeed, but there are so

many "ifs" concerned with them, that the mere fact of torpedo-boats existing must not be allowed to drive our blockading fleet away. As to the risk run in the case of large ships, there is another view to be taken of the question; the larger the ship the better she is able to withstand the damage that might be inflicted by a torpedo, and what might sink a small ship may not materially affect a large one. I think what the employment of torpedo-vessels should tend to, is to develop the defence against those torpedo-boats which I cannot think has received sufficient attention. There are more ways than have yet been tried of developing the question of defence against them. Next comes "The advantage of being able to inflict damage upon the shipping which may be under the protection of land fortifications, or to close the port, will also be so great that the mode of attack must modify itself to suit the change in conditions. There can be no doubt, I think, that the gun-vessels with numerous long-range shell guns, and costing not more than one-fourth of the modern battle ship, will displace the battle ship for this service." The question with regard to this must depend a great deal upon the ships to be protected, and the protecting forts themselves. We will suppose that a fleet is blockaded in an enemy's ports, or in one of our own ports; surely there are different descriptions of vessels required for the blockading of a port that is holding a fleet, and a port that contains no fleet, only simple merchant vessels. Supposing the "Inflexible" was inside a port attempted to be blockaded, I am sure her late gallant Captain, who I am glad to see present, would not allow himself to be blockaded by any unprotected vessel however large her guns might be. I do not think the "Inflexible" would mind any amount of the vessels hereinafter described in this paper. Mr. Barnaby says the guns that can be mounted and worked at sea with advantage in vessels of very moderate size may be of considerable power, and he afterwards describes a ship of from 2,000 to 3,500 tons with a gun of from 25 to 30 tons in her extremes. I would ask what is this ship really intended for? If she is built for the purpose of engaging large ironclads, I dispute the advantage which the ship would have at all. If she is intended for the purpose of attacking unarmoured ships, in my opinion a broadside of lighter guns would be far more efficient. Mr. Barnaby says "this justifies the expectation that the protected battle ship proper will require guns of larger size and power than 30 tons, so long as such larger guns are found to have advantages." Perhaps he will explain this a little further; I do not understand how he arrives at this deduction—that because a small vessel can carry a 30-ton gun, that a battle ship requires larger guns. With regard to the projectile, Mr. Barnaby, I think, asserts that it is necessary that we should have shell, and that we have not arrived at any material that will drive a shell through armour. This is quite right as far as it goes; but is it necessary that we should have shell? I do not think that we can get shell to do what he mentions. Is not the effect of a solid projectile, or a partially solid projectile, passing through armour and scattering the *débris* and splinters in all directions very effective? The paper then says, "The questions raised in this paper which seem to be debateable are—first, should England build ships greatly exceeding in speed, coal endurance, guns, and armour existing ships of the first class, regardless of size and consequent cost?" In my opinion she should—not greatly exceeding, but exceeding the power of any other ship afloat. I do not think we should initiate the policy of building extraordinarily large ships, but if our probable enemies possess ships of very great power, I think it is our duty to build ships that can excel them in all respects. It would not be fair to our Officers and men to put them in ships inferior in any single point to what our enemies might have, and expect them to do what their forefathers did, and hold England's place in the world which they gained for her. The second question is, "Will not the enemy's ports require to be attacked and blockaded, notwithstanding the torpedo? and if so, what description of ship will be suited for this attack?" This must depend entirely upon circumstances. We must be prepared for what is inside, and one description of ship will not suffice for all duties of blockading. If we attempt to bring these duties into the scope of one ship, we shall simply have a compromise which will answer no purpose properly. Then, with reference to the third question, "Ought regular ships of war to be built of sufficient power and speed to capture ships like the 'Servia' and 'Alaska,' and their larger and faster successors? or should we not rather look to the services of such ships for

the work, endeavouring to fit them for it?" In my opinion we should build some. There are not many "Alaskas" and "Servias," as we see by the diagrams before us. To protect themselves I think it is necessary for our merchant ships to be armed. For the attack of an enemy's merchant navy and to destroy her commerce, I think we must have a certain number of very fast regular war-ships equal to any in speed, and possibly in coal endurance. Mr. Barnaby thinks the "Alaska" and those very fast vessels will be extended, but I am not quite so sure of that. Some of those ships, I understand, are not profitable. With reference to the "Alaska" herself, I have heard it said that so much of her space is devoted to engines and coal stowage, that there is not sufficient room for cargo to make her a profitable investment, therefore I do not think the extension of this class ship is so certain. I will not say anything as to the fourth question, it is too extensive to be discussed now, but pass on to the fifth, viz.:—"Ought the battle ship of the first class to carry guns of the largest calibre which can be made and worked, or should we be content to allow the gun to progress slowly with the advance of the armour?" My view is that the battle ship must carry guns somewhat exceeding the power of any of the enemy's ships, not the largest that can be made, that is probably unlimited. We can do it; we can mount the guns, and can work them, and I think it is a great satisfaction to know that we have such an establishment in the north as Elswick, another arsenal, and, I understand, what is to be another dockyard, where we can have honourable rivalry in gun-making and ship-building. I do not think Mr. Barnaby will object to any honourable rivalry in such a concern as that, and all I can say is that I wish it every success.

Admiral RYDER: Mr. Barnaby's meaning is no doubt very clear to himself, but there seems to be an opening for no little confusion in the minds of his hearers and readers, as to the distinction which he indicates, but does not explain, between a *protected* ship and an *armoured* ship. He uses the words "protected by armour," and then he says "a ship is not protected," and again, "she is protected." I think there is no little confusion running through the paper on this point. Mr. Barnaby might clear it up by putting in this note, viz.: "The expression 'armour' is confined to *side* armour, and that by a 'protected vessel' he means a vessel without side armour, but with a plated deck." At present there is no little ambiguity, I think, and other readers and hearers of the paper beside myself have noticed it. Mr. Barnaby proceeds to say: "The result will, I believe, be that *the armour will finally nearly or quite disappear as side plating for the hull of the ship, and that where it must continue to be used for the protection of the gun and its mounting, it will improve in quality, so as to be impenetrable to shell, however made.*" I think that is a very important statement. Some years ago I had the honour to be on the Committee of Designs, when there was a small minority, Admiral Sir George Elliot and I, that strongly advocated this view, but at the time it was not received with any favour, either by the authorities or by our brother Officers. I am glad to learn that so distinguished a judge, in such a matter, as Mr. Barnaby has been converted; I do not know what his opinion was then. Whether *we* converted him then, or whether he has been converted lately does not signify, but we claim him as a most distinguished convert to our view. We hope the authorities, who undoubtedly consider as of the greatest weight all that Mr. Barnaby says, will really consider this question very attentively. If Mr. Barnaby believes, and has no hesitation in stating, that we should proceed in future in this direction, viz., armouring the *guns*, the *ammunition uptakes*, and the *deck below the water* to any thickness that can be safely carried, and in getting rid of all side armour, beyond what may be sufficient to resist the projectiles of machine-guns, surely the experiments asked for unanimously by the Committee on Designs many years ago, and again now by Mr. Barnaby, should be carried out. I am very glad to have another opportunity of recalling my brother Officers' attention to this important subject, viz., of *replacing side armour* in the most powerful battle ships, *by a plate-protected submerged deck*, because it is a question which has been very much lost sight of in that class of ship. As the subject is only alluded to in one short, but most important, sentence in Mr. Barnaby's paper, it might have been overlooked unless I had attempted to give emphasis to it by the above remarks.

Captain P. H. COLOMB, R.N.: This is a paper which requires, I think, from us

all, the very gravest consideration, not only from the subject-matter of the paper itself, but from the position that Mr. Barnaby holds, as practically at the head of the naval architects of the world; and because we may be perfectly sure that even a hint which he appears to drop in a particular direction will be taken up by the public and the press of this country, as pointing out the direction which ought to be followed. Therefore I think that speakers should devote their attention on this occasion to statements in which they disagree, rather than in uttering agreements which would occupy time, and which would be no flattery to a gentleman in Mr. Barnaby's position. I very cordially endorse the last sentence in the paper. We should certainly get on high ground, and the only caution I should give would be that we must take care that the high ground we get on is solid ground, not made ground; because made ground may slip away from us. On this account I have great fear of these large and vague generalities. If I were to put my finger upon the great error of the age, I should say that it was the assumption of a great generality—the establishment of a piece of made ground—without having taken sufficient precautions about seeing that the basis on which we stood was solid. I am quite sure that on the question before us to-day more precision is necessary, and I am also sure that more precision is possible. I will give one or two instances where I think that precision is wanting. The lecturer, quoting Signor Brin, says—"The slower group cannot overtake the single faster ship." That is a question of relative strength. If the group is stronger, the faster ship flies: if the faster ship is stronger, she will not want to use her speed. There may be a faster ship in the slower group, which is quite competent to bring on action if desired." Again—"The faster ship can always be mistress of the situation, and maintain herself in the front, in the rear, and on the flank of group, at whatever distance she pleases." Here we have very confused notions of the fighting value of speed. What is the fighting value of speed? First, to bring an unwilling foe to action: secondly, being weaker, to allow of your escape: third, to choose your range, but only on the condition that you fight a stern battle—you cannot choose your range on any other condition: fourthly, to ram the enemy from a safe position abaft his beam; but then, again, provided that the enemy's manœuvring power is not relatively as superior to yours as your speed is to his. Speed by itself will win no battle. A shorter, or a longer range, is not, in itself, an advantage between equal ships. I will take a third instance of where, I think, the generalization has been improper. Signor Brin says the large ship, by combining greater defensive "and offensive powers, can employ with greater precautions for herself, and with greater probability of success, the terrible torpedo." But is not this assuming all the questions at issue? A large ship means relatively bad manœuvring powers, a relatively larger target for the torpedo to hit, and a heavier loss if she is struck. Is there any ship, large or small, in existence, which is capable of standing with impunity the fair blow of a Whitehead? I do not think that we can usefully speak in such general terms: I think we must ascertain or assume relative values for the different weapons, and that we must build ships to employ each to the best advantage. Recurring now to the paper itself, I must agree with Admiral Boys in demurring very strongly to the term "battle ship," as being too vague, and apt to lead our minds away from precise definition. I ventured, some years ago, to propose that the term "line-of-battle" ship should be superseded by the term "fleet ship." The line-of-battle ship was meant, built, and armed to fight in a particular formation—the line of battle. We do not now know what the proper formation is, but we do know that ships must still fight in fleets; and I think we ought to use that term—fleet ship—as drawing our minds at once to the sort of ship we mean to talk about. Following Admiral Boys, and I suppose I shall have all naval Officers with me, I very much disagree with the classification, at the beginning of the paper, as to the power of waging naval war. I look upon the Mercantile Marine as a naval weakness, not as a strength. I thought so before I came into this theatre: since I have seen this diagram my impressions are very much strengthened. I see these two enormous black squares under the word "England," and I see a little blue square under the word "France," and I think to myself that little blue square is the master of anything within those two black squares, and I am assured that a Mercantile Marine, which is defenceless, is a weakness, and not a strength. In the

paper itself this is very distinctly shown in the case of America, where the only heavy blows that the South struck the North were in sweeping her commerce off the sea—which the North has never yet recovered. True, that the Mercantile Marine may be a strength if you duly incorporate it into fighting material, and keep it so; but it is not a strength in itself. I should put, certainly, as Admiral Boys does, the number and efficiency of the ships-of-war first of all: I should put the *personnel* next: the ability to produce war material third: and I should, undoubtedly, put the strength of the Mercantile Marine last. Those words recall to my mind a very extraordinary sentence published in a morning paper the other day, with reference to Sir Edward Reed's letter, where it was pointed out that we really need not trouble our heads about building ships, because we have plenty of iron and plenty of coal—as if iron and coal, in themselves, would fight our battles for us! We now come, I think, to some of the evils of generalizing in this way, for we find Mr. Barnaby speaking of "harassing the commerce of an enemy" and he puts it as if that was a thing that we were to prepare ourselves for. I think that is a very proper sentence to put in the mouth of a Russian, a Frenchman, a German, or an American, who is talking in his own theatre on a subject of this kind; but looking at these diagrams I really do not see what commerce we have to harass: the harassing, as far as I can make out, would be entirely of our trade. And then we have to recollect that while America suffered a heavy blow, from which she has not recovered, by the loss of her Mercantile Marine, it would be simply death to us to lose ours, or to have our commerce interrupted even for a short time. We are suffering from the evils of a long naval peace: we do not realize what it is to be navally on the defensive, and so we find the lecturer putting side by side two duties of a naval force, fights in the open sea and attacks on ports, and drawing no distinction between their relative importance. Then he goes on to say: "Operations on or in the neighbourhood of an enemy's ports, and attacks upon his commerce, are the two most important fields of maritime warfare. Fleet actions have hitherto grown out of them; and it is reasonable to expect that they will do so in future, and that the ships best adapted for these two fields of warfare will always be found in contending fleets." I suppose the lecturer assumes that this is true so far as *our* attack goes. It is perfectly true in the letter, but it is perfectly untrue in the spirit, because *we* have always been the enemy, and it is attacks on *our* coast, and ports, and commerce, which have hitherto brought about the naval action. Take Admiral Byng's action in 1756; what caused that? It was brought about by an attempted attack of the French fleet on our island of Minorca. What was Hawke's action in 1759? It was brought about to stop the invasion of the country. What was Rodney's action in 1782? The French were on their way to attack Jamaica. Lord Howe's action in 1794 might be counted on either side, because it was partly brought about by an attempt on the French commerce, but quite as much by the desire to protect our own convoy, which we knew to be threatened by the French fleet. What was Camperdown? It was an action to prevent the junction of the Dutch fleet with the Brest fleet coming to the invasion of England. The action of the Nile was brought about by an attack on the territory of an ally. Calder's action was to prevent a junction between the two branches of the French fleet, also planning invasion. Take the earlier Dutch wars: what were they? The two fleets, the English and Dutch, went into the North Sea, and fought it out for the command of the sea, and the only attack made on shores at all was made by the Dutch on *our own coast*. From the very first of our great naval battles down to the last, from the Armada to Trafalgar, it has been one unceasing rule that we have fought at sea to defend our own coast, and our own commerce, and not to attack those of the enemy. In formulating a naval policy we should not forsake the sure ground of history and experience, for the conditions and form of naval wars are only intensified, not altered. Our Navy, if we come to fight with a naval Power, or a combination of naval Powers, must fight a defensive war, and its only business will be to keep the highways of the sea clear. Until this is secured, nothing else should be thought of. Therefore it is that I fear this growing reliance on our merchant ships. No doubt they can harass an enemy's commerce, but can they protect our own? A fast merchant ship can run away from the heavier and slower man-of-war. The running away will not protect the

unarmed ship which cannot run away. I agree with Mr. Barnaby that the fighting fleet ship does not want exceptionally high speed or great handiness; I do not think these are so necessary for the fleet ship as staying power and great offensive and defensive power. But then fleets must have eyes, ears, and stings, of some speed; you must be ready in your fleet to provoke an unwilling foe to action. Mr. Barnaby tells us that the single gun cannot satisfactorily be mounted in a single ship, that you must have two, and he puts his tonnage from 2,000 to 3,500, and says because you must have that tonnage therefore you must have at least two guns. So far as any experiment in that way goes, it seems to show that very much smaller ships may carry single guns, even to be made fairly seagoing ships. The boats built for the Chinese Government carrying the 35-ton gun were only 440 tons; they had 10-knot speed, for six days: only costing 36,000*l*. The last pair were certainly larger; their displacement was 1,350 tons, but then they carried two 26-ton guns, and they had 16-knot speed. No doubt they were not what we call quite seagoing ships, but they seem to show that you may put a single gun in the centre of the ship of comparatively small size. Again, such ships as these, the fleet ships, must protect themselves by numerous guns; they need not be heavy, but they must be fought under thick plating. The heavy plated ship with few guns and low speed is only a prey to the faster, and lighter, and cheaper torpedo-ship. The fleet ship must have many guns to defend herself; first, against floating gun-carriages; secondly, against the small ones; and thirdly, against the torpedo-vessels; it must have moderate armour—which I always lay stress upon—moderate armour to protect the ship and men against light gun fire. The smallness of the target, as Mr. Barnaby points out, is really an efficient protection against slow fire from heavy guns. I think one of the first things we have to do is to seek out the best formation in which a fleet can fight, and we ought to build and arm our fleet ships with a view to this formation. As to the association of small vessels with fleets for fighting purposes, I must see a distinct use for them, before I accept Mr. Barnaby's dictum; eyes, ears, and stings they may certainly be, but as I understand Mr. Barnaby, he expects them to take their place in what is practically the line of battle, that is to say, they are to join in a naval action on an equality with the fleet ship, and this cannot yet be assumed. Then we come to the five questions at the end. In the first of these we are asked—"Should England build ships exceeding in character those large ships, the 'Alaska' 'Servia,' and so on?" and I believe most naval Officers would answer, with me, "No." To the second question, where he says, "Should we prepare to attack and blockade the enemy's ports notwithstanding his torpedoes?" I say "Blockade, yes; attack, no;" because I think you will waste your substance in preparing for the attack, until you have first banished his fleet from the sea. As to the kind of ship for the attack, of course, as I do not attack, I do not propose to build any ship for that purpose. In answer to Question 3—"Ought regular ships-of-war to be built of sufficient power and speed to capture ships like the 'Servia' and the 'Alaska,' and so on?" I say "No;" but it is essential to have a numerous array of ships, which would be the masters of the war ships launched to attack our commerce; and I think it is exceedingly dangerous to rely on the scratch services of the Mercantile Marine. As to the fourth, as to the powers of the ram and torpedo, I say we do not in the least know what part may be assigned to the ram and torpedo, and we shall never learn it by generalizing: but inductive reasoning and abundant experiment may, I think, teach us. I have, however, grave doubts as to the policy of the under-water armoured deck, and I am sorry to differ with my old chief (Admiral Ryder) so far. I still hold to the side armour, applied as it is in some foreign ships, with the horizontal armoured deck joining the upper edges of the side armour, the side armour being only carried up about 18 inches above the water. Then comes the last question—"Ought the battle ship of the first class to carry guns of the largest calibre which can be made and worked?" To that I say, I look to see the fleet ship with a more numerous artillery than they at present possess. If this cannot exist with the heaviest guns, then, I think, those guns will become lighter. Since I first began to consider these questions, there is no doubt that we are increasing, by all means in our power, the numbers of guns being carried in the fleet ships. At present it is a dual armament, that is to say, there are one or two very heavy guns, and a

numerous armament of light guns. I fully expect that the light guns will grow in size, and that the heavier guns will be reduced in numbers. I think the main point is this, that our material at present is a long way ahead of our power of judging what it means. I think we can only get at the rights and wrongs of the case by an earnest study of the historical and geographical facts; by close inductive reasoning, and by unstinted and abundant experiment. I think that these things are the wants of the day, and I consider they are things which, pursued steadily, will give us a true and reliable naval policy.

Mr. GEORGE RENDEL (Lord Commissioner of the Admiralty): It seems to me that the all-important question raised by the distinguished author of this paper, and one which it is most desirable to bring to the test of naval opinion, is whether it is possible so to modify the construction of the Mercantile Marine, or rather of selected ships of the Mercantile Marine, as to render compatible with their trading qualities a certain measure of efficiency as ships-of-war, and thus to provide a large naval reserve always available for the protection of our commence. I think that is a question which more than any other in the paper is one for the attention of the naval members present. What are the alternatives? As far as I understand the question, one alternative is to add to the Navy a number of very swift partially armoured vessels of war specially built to act as the guardians of our commercial ships. Now, there are one or two considerations which seem to make that course a very difficult one. In the first place the number of vessels required would be something enormous. If we make the supreme effort required to provide them, we have to remember that not only would their maintenance be extremely costly, but they would rapidly depreciate in value from the progress of science. As an example, if we assume that that course had been followed some fifteen years ago, we should certainly have had vessels engined in a manner that would have rendered necessary a complete refitting of engines and boilers a few years later, because it would be absolutely essential to maintain such vessels at the maximum point of efficiency, and for this purpose compound engines must have been substituted for the engines previously used. Again another period of a few years and we should have found ourselves in the presence of the fact that such vessels must be of steel, to cope with their rivals of the day. Again a reconstruction of the fleet. On the other hand, if it were possible to make the commercial navy self-protecting, or to a large extent self-protecting, we should be sure always to have in vessels selected for that purpose the latest improvements, and to have them at a very trifling cost, because naturally ships would drop out of the list as others of greater power came in. Then, instead of viewing with as much alarm as pride the growth of our great Mercantile Marine, we should view it with unmixed satisfaction. We should remove the perhaps greatest preoccupation of those who have to direct our naval policy and naval construction; in short, the object to be attained is so important that one cannot but think that a very careful examination of the question ought to be made. Already something has been done. A very few years ago there were but three or four vessels in the Mercantile Marine that could be said to be safe against the danger of being sunk by a single opening below water. Already, and absolutely without any expense to the country, by the initiation of the Admiralty, a large number of vessels have been built for the Mercantile Marine so divided as no longer to run the same risk. To a certain extent also the coal spaces have been rearranged to afford some protection to engines and boilers against artillery fire. Is it not possible to go further? If so much has been done without paying a single penny beyond the mere trifle spent for inspection, is it not possible to induce shipowners to construct vessels more adapted for being armed in time of war? To put their engines below the water-level, and to introduce a deck at or below the water-level,—to assimilate their ships in fact to the type we should probably build if we had to provide for the same duties by a special ship-of-war? The subject is one of such vast importance to the defence of the maritime interests of the country that it cannot be too thoroughly and carefully investigated.

Captain ORDE BROWNE, late R.A.: I want to raise one or two questions with reference to the three guns shown by Mr. Barnaby on the diagrams. I believe we require at this moment to take some important steps in order to understand the question of hard armour, and by hard armour I mean armour that cannot have a hole

made in it. Our guns and projectiles have hitherto been developed entirely against soft armour. The only diagrams we have in the Service relate to punching holes in iron armour. In the same way the chilled projectiles that form a great part of our stores were entirely intended for punching soft armour, and the new type guns owe their existence and position to the fact that it was found that you could penetrate soft armour with comparatively small guns. The whole of that applies to soft armour, and the whole of that, I believe, is liable to mislead us when once we have to deal with hard armour. The very success of those guns was suicidal; you had only to prove that you could drive a steel projectile, containing a bursting charge, clean through soft armour, and it would become quite clear that we must have something else, because naval architects would say it was much better to have steel armour that would smash up gradually than to have soft armour to let the shell go clean through and burst inside. The result is that by degrees steel-faced armour has been adopted. Supposing, as Mr. Barnaby assumes, that armour almost entirely goes out for ships, then you have to consider the question of hard armour for forts to a certain degree. Now we have to face this extraordinary result that, as soon as we try experiments with hard armour in this country, the first conclusion we come to is that our chilled projectiles are no use. Colonel Inglis will correct me if I am wrong. The Committee on Projectiles concluded that our chilled projectiles are of no use. And then we have brought into contrast with that this year the fact that the very best steel-faced armour that we can make is knocked to pieces by chilled projectiles at Spezzia and St. Petersburg, and by chilled projectiles whose stored-up work is only about a match for the armour. That is an illustration of the fact that we have been experimenting in this country a great deal too much on soft armour, and that we require urgently for the future to make experiments against hard armour of different kinds, chilled armour as well as steel-faced. We have never fired one round at Grüson's chilled armour in this country, notwithstanding the fact that all the forts of foreign countries are defended by chilled armour. The power of the guns for punching ships depends inversely upon the diameter of the hole you make, and the power of those medium guns is very great, because the diameter of the hole they make is small; but you cannot avoid having in some shape or other to attack chilled forts, and then you have to consider what the guns would do against them. Take those three guns and take their punching powers and their powers against hard armour. Their punching power is what they would do against ordinary iron armour, and their stored-up work represents their effect against hard armour. The following are the results: the 43-ton gun would penetrate 26·1 inches of iron, the 80-ton gun would penetrate 26·6 inches of iron; and the 100-ton B.L. would penetrate about 30·7. There is nothing grossly disproportionate in that. But now take the stored-up work as measuring the effect against hard armour. The 43-ton gun has a force of 23,320 foot-tons, the 80-ton gun 32,938 foot-tons, and the 100-ton B.L. 46,640 foot-tons. The last is exactly double the work of the 43-ton gun. The question we have to consider is, whether you can afford to have guns whose penetrating powers may appear to be not very much in excess of your own, but which, if brought to bear against hard armour, will produce twice the smashing effect of the biggest guns we have afloat.[1] I think those experiments are needed. This is only one branch of the question we have before us to-day, but it has occupied a certain amount of room in the paper and deserves attention.

Mr. POUNDES: The question of the Mercantile Marine has been brought very prominently before us to-day, and we have been favoured with valuable diagrams of the highest types of fast ships of the Mercantile Marine, but it has not been remarked that the necessities of merchant ships are altogether different from those of men-of-war as to high speed, a merchant ship during "her lifetime" requiring a high speed at all times on long voyages, economy of space and of consumption of coal being absolutely demanded. We all know that to obtain a good coefficient, we must have a very great length, so as to get the smallest possible immersed section, and to make the best use of our propelling power. It is also necessary to carry a large amount of cargo, and to have a very considerable

[1] Except those on board the "Inflexible."

space for passengers. But when we come to consider a fighting vessel, not necessarily a vessel for cargo or passengers, but merely a vessel to progress at high speed, then the naval architect has something very different to consider, and the very first point is as to propelling power. The propelling power that it would be possible to introduce into a merchant ship of large displacement would be altogether unsuitable in a very much smaller vessel; and I look forward to the time when we shall have great improvements in steam generators, in various forms of boilers, and also in small direct-acting engines, with screws of a smaller size, very high piston speed, more indicated power, and working with a greater degree of efficiency, and allowing us to have vessels of much smaller size, simply large floating gun-carriages, that would at the same time have a sufficiently ample storage of coal for any emergency. We do not require to build ships like merchant vessels; we require vessels irrespective of economical considerations with regard to the consumption of coal, &c.; vessels that can be economically worked under ordinary circumstances, but under *extraordinary* pressure can be worked up to the very highest speed possible. Therefore we have before us a possibility of building an entirely different type of ship, quite able to overhaul any of the very high speed steamers being projected now either at Barrow or Belfast or by any of the eminent builders, such as Harland and Wolff or others, for the several companies. The merchant service has been referred to by some naval gentlemen. As a matter of fact our merchant service is our great wealth. Not a single speaker has alluded to the necessity of assisting any of our Colonies. Captain Colomb has, however, frequently spoken on this question, but it has not been mentioned to-day. Indeed, from 1854 to the present day little or no progress has been made in the discussion that occurred on this subject when I was a youngster out in the Colonies, at the time when we first started in Victoria. Even then it was decided to have very high speed vessels, in case the Russians, with whom we were at war, attacked our "gold" ships; however, with regard to this subject, if it were in order to-day, I think I could show that our merchant service is really a great factor in the future. The paper to-day is not upon manning the fleet, but I think our Mercantile Marine, as shown on those two diagrams, could be made very valuable auxiliaries, especially if we had a few fast vessels, of an entirely different type, to protect and co-operate with them, able to overhaul and capture any high speed vessels that could be brought to bear against our Mercantile Marine. I believe these merchant vessels would make a much more practically useful school than our large ironclads can do, for our costly young naval Officers of the present day.

Captain J. C. R. Colomb, R.M.A.: I rise to appeal to the meeting. I think there is a great tendency in the discussion for the whole matter to drift towards one point of the paper only, namely, the question as to merchant ships. Mr. Barnaby—the first authority in the world—comes and reads a paper, which I think is most suggestive, and he says his duty is to observe tendencies, and I take it also to weigh opinions. I appeal to naval Officers to speak out. Feeling, as I do, our great maritime danger, I do hope, Sir, this discussion will not close until many more naval Officers I see present, who are capable of expressing an opinion, have entered more fully and more directly into the other most important parts of the paper which has just been read.

Mr. Donaldson (Thornycroft and Co.): I was very much pleased to notice that Mr. Barnaby fully recognized the value of torpedo-boats in the defence of ports, and I think it would be a valuable addition to his paper if he were to give us some idea of the relative number of first-class boats suitable for this purpose in our own Navy and in those of France, Italy, and Germany. My firm has been engaged for some years in the manufacture of torpedo-boats, and large numbers are gradually being accumulated by the more important European Powers. We have manufactured twelve for England, twelve for France, and twelve for Italy, and I believe at the present time there are something like seventeen first-class torpedo-boats in the English Navy. The French have largely supplemented the number we have supplied them with by boats built in France, and now, I have been told, they have at least thirty first-class boats in their Navy. Only a few months ago an Italian constructor told me he had an order from the Italian Government for thirty first-class boats, made from our drawings. Germany is making torpedo-boats very largely also, and if Mr.

Barnaby could give an appendix to his paper showing the exact number of torpedo-boats belonging to these different countries I think it would have a very important bearing on the question before us.

Captain HARRIS, R.N.: I am somewhat diffident in making any remarks on the valuable and highly instructive paper and discussion which we have just had the pleasure of hearing. There are, however, one or two points which seem to have escaped observation. It strikes me as a very serious question, and one worthy of deep consideration, that the moment war breaks out we should propose to take all the steamers which from their high speed could not be captured by the enemy, and which, generally speaking, could run with celerity from port to port with almost perfect impunity, and turn them into armed cruizers, when these would be the very ships wanted at that time to supply our hungry people with food. I think, therefore, that it is a very open and somewhat doubtful question whether these fast steamers should be taken away from commerce for war purposes, leaving, as we see so admirably illustrated in Mr. Barnaby's diagrams, that large and helpless mass of slow steamers and sailing-vessels to carry out and provide for the never-ceasing wants of our teeming town populations. There is another point I should wish to briefly mention, it is as to the policy of the Italians in building these very large ships. No doubt the building of an enormous ironclad is to a certain extent a menace to England, because we are the most powerful nation afloat. But there is another way of looking at it, and I think if we could persuade nations like Italy, and even larger nations, to throw their whole resources and strength into monster armour-clads, when their finances will certainly not permit the construction of more than three or four of them, that we then with our more numerous vessels should have no difficulty in mobbing them in their own ports. Thus I think Signor Brin's policy of making a comparatively poor nation build very expensive and enormous ships is a good policy for England. I may say that I quite agree with Admiral Boys and Captain Colomb as to the inversion of the first paragraphs of this paper. I think they stand altogether on their wrong base, and that in reality our large and extended Mercantile Marine is a great source of danger and anxiety to us, and cannot be regarded in any way as a source of strength but as a necessary weakness to be jealously guarded and defended. Mr. Barnaby has made one remark with which I most cordially agree, that is, as to whether it is wise to introduce large guns afloat. My opinion on this subject is, that the Navy as regards its readiness to take heavy guns is a long way ahead of the supply, indeed of any gun we have yet got afloat; judging from the facility with which we have passed from a 6½-ton gun to a 100-ton gun, I think it may be safely predicted that we are quite capable of efficiently working guns of much greater power in all ships. It seems to me that putting in small guns is simply waste of time, because we have, so far, not nearly reached the limits of either size or power in this matter of naval guns.

Mr. BARNABY: I think I need, perhaps, to offer a few explanations at once, and those are, first, as to what I mean by a battle ship, and, next, what is meant by a protected ship, and I must confess it is very difficult for me to say. We talk commonly about armoured ships and unarmoured ships. These two great Italian ships ("Italia" and "Lepanto") have not any armour on their sides at all, they have armour for the protection of their guns, but they have none upon their sides. We have ships in our Navy and ships are being built in England, for foreign Powers, with very strong protecting decks, either below or just above water, such as those which have been talked about by Admiral Ryder (I remember, of course, perfectly well all that he has been referring to: I think he was a little ahead of the times, as I am to-day). But there needs some change in the terms that we use. We cannot stick to the terms armoured and unarmoured, as at all marking the difference between the classes of ships with which we are now dealing. There are protected ships which you cannot call "armoured" ships. If you call them "unarmoured" ships you degrade them into positions they ought not to be in, because being what I call "protected," that is, having no side armour, but strong protecting decks, it may be that they are capable of fighting with the battle ships. In my opinion they are. In my opinion ships of 17 knots, with powerful guns, and a protecting deck from end to end, with engines, boilers, and steering apparatus all protected, with the deck, if you will, so situated with regard to the water, that your floating

power and stability are both preserved, cannot be properly called unarmoured ships. We are not at liberty to call them armoured ships, so I call them protected ships.

What are "battle ships?" Captain Colomb says: "I call certain ships fleet ships." Well, why? "Because you may expect to find them fighting in fleets." Well, you may expect to find any of those ships, which I have called battle ships, fighting in fleets. Some of the ships which are there we call "coast defence ships," but the fact that they are coast defence ships is shown by the smallness of their size. They do not actually count as battle ships, but I have put them in the diagram because I consider that those ships can fight, in proportion to their size, as well as the others. In the French Navy there are ships of great power which they call "coast defence," but which are as well able to fight a battle in the Mediterranean as any of the ships they have. Therefore, I have to explain that these might be called ironclad ships rather than battle ships; but I defend the term I have used, because those ships might be expected to be found in battle in any part of the world where you could send them. With regard to the experiments that Captain Orde Brown referred to, I am entirely of his opinion that we need experiments very badly indeed in order to ascertain what is the gradual increase of resisting power as you thicken armour-plates. I do not know what it is, and it is absolutely necessary that experiments which have for some time gone on rather slowly should be taken up with more vigour than we have recently been able to show in that matter, because of their great cost. The armour of to-day is exceedingly costly.

I should have been glad if I had been able to say that the answers to the questions had convinced me that the opinion of this meeting was so and so; but at present I am not able to say anything beyond this, that you are certainly of opinion that at present, whatever it may be our duty to do with regard to the merchant shipping of England, we cannot regard it as a very great power for ourselves. My question has been, ought we not to try to make it so?

The CHAIRMAN: I have only now to ask you to enable me to give your thanks to Mr. Barnaby for the very admirable paper that he has read to-day. I am quite sure when Mr. Barnaby says he fails to sum up any results from the discussion, you will not expect me to attempt to do it. I, therefore, have only to thank Mr. Barnaby on your part, and my own, for his very able paper.

Friday, February 16, 1883.

LIEUT.-GENERAL SIR EDWARD B. HAMLEY, K.C.B., K.C.M.G., R.A., Member of Council, in the Chair.

THE EFFECTS OF THE BOMBARDMENT OF THE FORTS OF ALEXANDRIA, JULY 11TH, 1882.

By Captain N. L. WALFORD, R.A.

PART I.

SIR EDWARD HAMLEY, LADIES AND GENTLEMEN,

IT is perhaps scarcely necessary to draw your attention to the value of a detailed report of the effects of the bombardment of Alexandria, since we are all aware of, and all appreciate, the fact that this is the first occasion on which modern ships, armed with modern guns, have engaged land batteries armed with similar weapons.

The bombardment of Sebastopol, and of the Russian forts in the Baltic and the Black Sea, are now as useless, as far as regards the worth of any information to be obtained from their history, as are the bombardments of Algiers or of Acre, and if we turn to more recent engagements, such as those which took place during the war between Chili and Peru, we shall, I think, find that, at least in the majority of cases, such bombardments consisted merely of the destruction, by ships armed with long-range guns, of cities and towns of which the defenders possessed no ordnance of sufficient power to molest the attacking force.

With these few introductory remarks, for our time is limited, I pass on to the subject of my paper.

Defences of Alexandria.

The city of Alexandria is situated on a strip of land between the Mediterranean Sea and Lake Mariout; a considerable portion of it stands on a promontory, which, jutting out towards the north-west, is bounded on the north-east and south-west by the New and the Main Harbours. (Plate V.)

Strictly speaking, the sea defences of the city extend from Fort Silsileh to Fort Meks, a distance of about 6 miles; the action, however, of some portion of the fleet during the bombardment included also Fort Marabout, which is about 9 miles from Silsileh.

The defences consist of the following forts and lines:—

(i.) *Fort Silsileh*, which guards the south-east corner of the New Harbour.

To the south-west of this fort stands the Quarantine Fort, of which it is not proposed to give any details, since it was not affected by the bombardment.

(ii.) *Fort Pharos* or *Kaid Bey*, standing at the north-west corner of the New Harbour.

(iii.) *Fort Adda*, about 800 yards to the west of Pharos.

Between these forts is a lunette of good profile, but of poor armament: it was not engaged on the 11th of July, and need not be again mentioned.

(iv.) To the south-west of Fort Adda, on the opposite side of a small bay, is the right battery of Ras-el-tin lines. This is generally named *The Hospital Battery*, since it stands in front of a large building bearing that name on the map.

From this point the lines follow the coast, until at the north-west angle of the Harem (or Children's Palace), they widen into a battery, which has been generally spoken of as the Moncrieff gun battery. Since, however, this is completely a misnomer, it will perhaps be better to call it *The Centre Battery*.

Thence the lines, following the shore, run on to the south-west to the *Harem* or *Left Battery*, a small work of no great defensive value; from this last they extend as far as Fort Ras-el-tin. The total length of these lines is about 1,500 yards.

(v.) *Fort Ras-el-tin.* This work lies at the extreme point of the spit of land which forms the north-west shore of the Main Harbour; it guards the breakwater, and covers the narrow passage between the latter and the coast.

(vi.) On the opposite side of the harbour stands the small fort *Saleh Aga;* it is in part old, is altogether obsolete, and requires little further notice.

(vii.) About a mile to the south-west of Saleh Aga stands a fort named *Oom-el-Kubeba* (the Mother of the Little Dome). This is a very old and in many ways a very remarkable fort, but is not well suited to modern weapons. Between Saleh Aga and Oom-el-Kubeba stands a small battery armed with four guns.

(viii.) A few hundred yards to the south-west of Oom-el-Kubeba is *Fort Kamaria*, a poorly-armed redoubt, which calls for but little notice.

(ix.) The *Meks Sea Lines*, which commence about 400 yards to the south-west of Kamaria, extend along the shore for a distance of about a mile. The left flank is covered by—

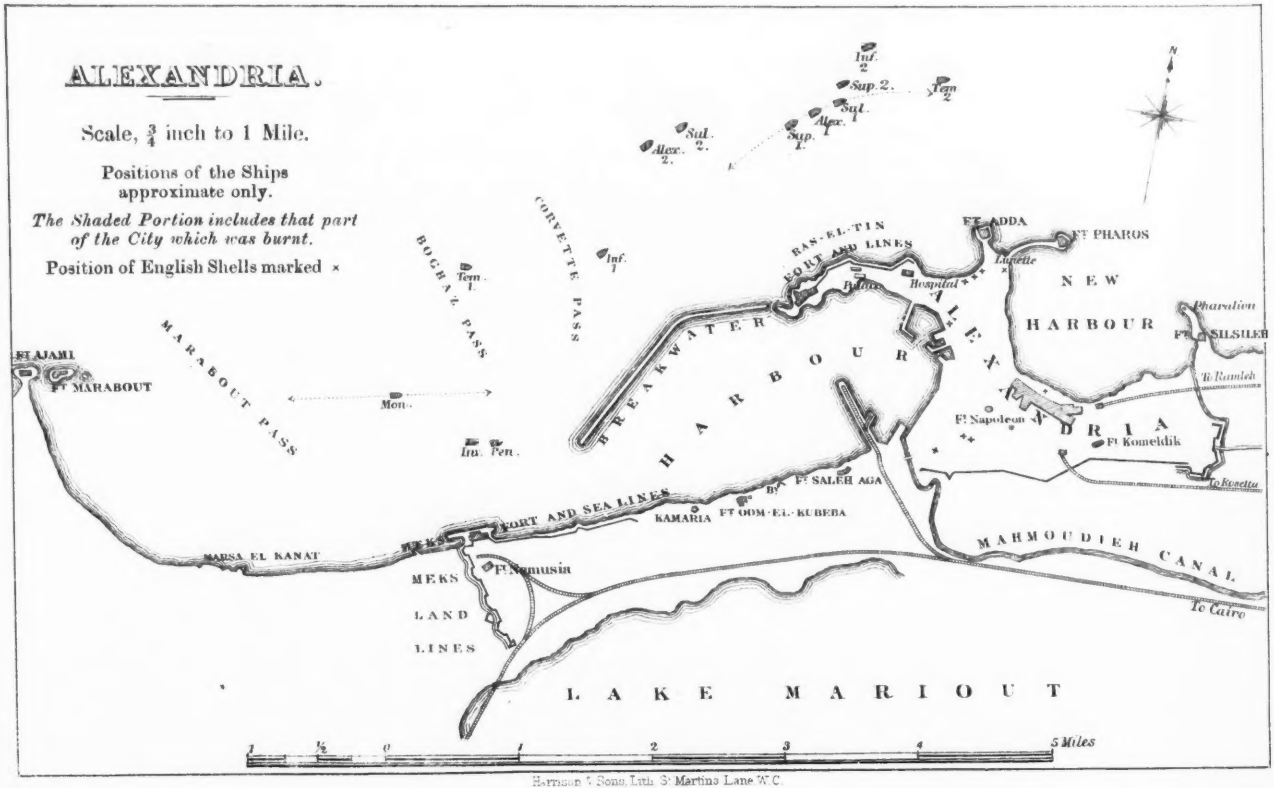
(x.) *Fort Meks.* This fort stands at the junction of the sea and land lines, of which the latter, extending nearly to Lake Mariout, defend Alexandria from the attack of an enemy who may have been landed at some point further to the south-west.

The *Citadel*, or *Fort Namusia*, took some little share in the defence.

Beyond the Meks lines stands an insignificant work, named Marsa-el-Kanat, while at a distance of more than 3 miles from the former are the large forts, Marabout and Ajami.

Composition and Armament of the Attacking Fleet.

The Mediterranean Squadron, upon which devolved the task of bombarding the above-mentioned defences, consisted of the ships mentioned in the following table, in which their armament is also included:—



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Ships Engaged in the Bombardment.

Ship.	Guns.									
	16″	12″	11″	10″	9″	8″	7″	64	40	Total.
"Alexandra"	..	..	2	10	..	..	..	..	..	12
"Inflexible"	4	..	..	..	..	..	..	..	..	4
"Superb"	..	..	..	16	..	..	..	..	..	16
"Sultan"	..	..	..	8	4	..	..	..	..	12
"Temeraire"	..	..	4	4	..	..	..	..	..	8
"Invincible"	..	..	..	..	10	..	..	4	..	14
"Monarch"	..	4	..	..	2	..	1	..	..	7
"Penelope"	..	..	..	..	..	8	..	..	3	11
Total	4	4	6	38	16	8	1	4	3	84

Each ship had in addition from 6 to 8 20-pr. R.B.L. guns, and also from 8 to 12 machine-guns.

Gunboats, &c., "Beacon," "Bittern," "Condor," "Cygnet," "Decoy," and "Helicon."

The Action of the Fleet.

The fleet was divided into two squadrons, as follows:—

"Alexandra"
"Superb"
"Inflexible"
"Sultan"
"Temeraire"
} Outside Squadron.

"Invincible"
"Monarch"
"Penelope"
} In-shore Squadron.

From the commencement of the action (about 7 A.M.), the stations were as follows:—

(1st phase. 7 A.M. to 10.30.) The "Alexandra," the "Superb," and the "Sultan" engaged the forts and batteries from Ras-el-tin to Pharos.

These ships were under way until about 9.30, and up to that time engaged at a range of from 1,500 to 2,400 yards. They then anchored at a range of from 2,200 to 3,550 yards, firing principally on the Ras-el-tin Fort and lines.

The "Inflexible," stationary but not anchored, engaged Fort Ras-el-tin (at 2,700 yards), and Oom-el-Kubeba (at 4,000 yards).

The "Invincible" and the "Penelope," at anchor, at a range of 1,500 yards, engaged Fort Meks.

The "Monarch," under way, at various ranges, engaged Meks Fort and lines, and Oom-el-Kubeba.

The "Temeraire," at anchor, at a range of 4,000 yards, supported the "Invincible" and the "Penelope."

(2nd phase. 10.30 A.M. to 1.30 P.M.) At or about 10.30 A.M. Fort Ras-el-tin and Meks Fort were silenced.

The "Alexandra" and the "Sultan" then engaged the West Battery (Harem), which was silenced about noon; they then attacked the Centre Battery.

The "Superb" engaged Adda, and the "Temeraire" Pharos, while the "Inflexible" divided its attention between these two forts.

The "Monarch" finally silenced Oom-el-Kubeba, about 1 P.M.

(3rd phase. 1.30 P.M. to 3 P.M.) At 1.20 a shell from the "Superb" blew up the magazine at Adda, which was then silent.

The "Temeraire," "Inflexible," and "Superb" continued to bombard Pharos, which was silenced about 2.30 P.M., at which hour also the Centre (Moncrieff) Battery ceased to reply to the "Sultan" and "Alexandra."

The "Inflexible" and the "Temeraire" then turned their attention to the Hospital or Bluff Point Battery; this was silenced by 3 P.M., but, venturing on the 12th again to open fire, it was finally silenced by seven rounds from the same ships.

Between 3 P.M. and 5.30 P.M. (at which latter hour all firing ceased by signal), a few shots were fired at the forts with the object of preventing the garrison from attempting to bring their guns again into action.

The "Alexandra" also threw some shell into Fort Silsileh, while in the earlier part of the day some of the gunboats had been employed in shelling Fort Marabout, and in covering with their fire a landing party which succeeded, without opposition, in dismounting some of the guns at Fort Meks.

As many of us are accustomed to judge of the size of a gun by the weight of its shot rather than by its calibre in inches, the following table is added:—

Details of Heavy Ordnance used at the Bombardment of Alexandria.

Gun.	Weight of gun in tons.	Charge in lbs.		Empty shell, weight.		Bursting charge, weight.	
		Service.	Battering.	Common.	Palliser.	Common.	Palliser.
				lbs. ozs.	lbs. ozs.	lbs. ozs.	lbs. ozs.
16-inch gun ..	80	337·5	450	1640 0	1684 0	60 0	16 0
12 " " ..	25	55	85	590 10	608 6	23 6	5 10
11 " " ..	25	60	85	526 0	543 2	22 0	4 14
10 " " ..	18	44	70	390 7	406 0	19 9	4 0
9 " " ..	12	30	50	241 8	253 5	14 8	2 11
8 " " ..	9	20	35	166 0	174 12	15 2	4 8
7 " " ..	6·5	14	30	106 14	112 1	9 4	2 10

The general Character of the Defences and of their Armament.

The various forts and lines which together compose the sea-defences

of Alexandria differ considerably from each other in trace and profile, but they have many points in common to which it may be well to allude.

The *parapets* are without exception of sand, which is covered with a thin coating of cement; this is sufficient to prevent the wasting of the slopes by weather, but not to stop the growth of vegetation, and is so friable that it even breaks under the tread.

The interior slope, which is always revetted with stone, is invariably vertical; the superior slope has an inclination of about 5°, and the exterior of about 35°; the latter has generally one or more berms of 1 or 2 feet in width.

The *escarp*, except where it is very low, and the few counterscarps which exist, are revetted. The stone which is used for the revetments is a very soft limestone of no tenacity, and the mortar has but little binding power. The stores and buildings in the forts are constructed of the same material. The parapets in front of the rifled guns, which without exception fire through embrasures, are revetted to a height of 7 feet 6 inches; the parapet rises about 18 inches above the revetment with a counterslope of $\frac{1}{1}$. The S.B. guns, with rare exceptions, fire over a low parapet.

The *embrasures* have at the sill a width of 5 feet, which narrows to 3 feet 3 inches at about 18 inches from the neck; the splay is about 60°, and the cheeks of all embrasures are revetted with stone.

The *traverses* in the batteries for rifled guns are all fitted with expense magazines of the ordinary type.

No effort is made to give flank defence to any portion of the forts, nor, except at Silsileh and Oom-el-Kubeba, is there any instance of the use of a ditch.

The *buildings* in the forts are none of them bombproof, nor, except in Pharos, are there any casemates or covered batteries.

The Armament.

Rifled Guns.

10-inch M.L.R. Armstrong gun.
9 " "
8 " "
7 " "
40-pr. B.L.R. Armstrong gun, S.S.

These guns very closely resemble those in our Service, and call for no remark.

Smooth-bore Guns.

15-inch, about 10 tons, a magnificent weapon.
10-inch, in four sizes, from about 50 cwt. to about 8 tons.
6·5-inch or 36-pr., a poor gun, reputed to be of French manufacture.
10-inch howitzer, only one example.

Mortars.

20-inch, a very fine piece.
13-inch, S.S. and L.S., very like our own.

12-inch, a French mortar, in shape not unlike that on the Horse Guards Parade.

11-inch.

Carriages, &c.

The carriages and platforms of the rifled guns so closely resemble the Service pattern that little need be said of them. The racers are of iron, and are sunk in stone beds.

The platforms have invariably fixed pivots, which are, however, set in such inferior masonry that the stone has in many cases given way and jammed the front trucks of the slides. The holdfasts also have in one or two cases yielded to the shock of the recoil.

The carriages of the S.B. guns are all of wood, and are as a rule old and rotten; they have no elevating screws, and the guns have no sights, being laid with a quadrant, of which the arm is inserted in the muzzle.

The trucks are sometimes of wood for the lighter guns, but are as a rule of iron.

The platforms of the S.B. guns are, if possible, more rotten than the carriages; those of the smaller guns have two or three bearings, all fitted with trucks, but the 15-inch and the heavy 10-inch have a fourth bearing, which is a wooden chock.

The trucks of the platforms run on planks, which are arranged in a polygon, and are sunk flush with the ground.

The garrison carriages and their platforms are of the ordinary pattern; they are entirely out of repair.

Ammunition.

Rifled Guns.—The *shell* are similar to our own, but are studded and have no gas-checks; there are three kinds—Palliser, common, and shrapnel, and some of each stand by the guns. It appears probable that the shell were filled at the gun, since in one or two cases funnels were found in the gun portions.

The *cartridges* were filled with powder of a cylindrical form, made by Curtis and Harvey. It would seem that, as a rule, no filled cartridges were kept in the magazines, since in Fort Ras-el-tin only were any metal-lined cases found. From the appearance of the magazines it is probable that the cartridges were filled during the action, and the process must have been much delayed by the small size of the weights and scales. It is possible that this fact may account for many faults in the fire of the Egyptians, since it is not unlikely that the charge was frequently below the regulation weight. The cartridges for the S.B. guns were rough canvas bags, and were filled with a highly glazed L.G. powder.

Fuzes.—For rifled guns—

(*a.*) A time-fuze of gun-metal.

(*b.*) A large gun-metal percussion-fuze.

(*c.*) A small ditto.

(*d.*) A wooden fuze, similar to Boxer's time-fuze for rifled ordnance.

These fuzes are all of English make.

For S.B. guns and mortars were used four or five sizes of a rough wooden fuze, graduated but not numbered. It was sawn or cut, and not bored, to the required length.

Tubes. (i.) The ordinary service copper friction-tube.

(ii.) A short copper friction-tube (Egyptian), of which the detonator is fixed to a twisted copper wire, which forms a loop for the hook of the lanyard.

(iii.) A tube filled with mealed powder, to be fired with a portfire.

The *lanyards* had a wooden handle, which the number who fires the gun can grasp firmly.

The armament of the various forts is given in the following tables:—

Rifled Guns.

Forts, &c.	Mounted.					Unmounted.		Total.
	10″ M.L.	9″ M.L.	8″ M.L.	7″ M.L.	B.L. 40-pr.	10″ M.L.	9″ M.L.	
Silsileh	..	1	1	..	..	..	2	4
Pharos	1	3	2	..	2	..	..	8
Adda	1	3	1	..	..	..	..	5
Ras-el-tin Lines	1	3	2	2	1	..	..	9
Ras-el-tin Fort	1	4	1	..	..	..	..	6
Oom-el-Kubeba	..	..	2	..	..	..	..	2
Meks Fort	1	1	3	..	..	2	4	11
Total	5	15	12	2	3	2	6	45
	37					8		

Smooth-bore Guns and Mortars mounted.

Fort or Battery.	Guns.			Mortars.				Total.
	15″	10″	6·5″	20″	13″	12″	11″	
Fort Silsileh	..	3	..	..	1	..	..	4
„ Pharos	..	6	31	..	4	..	..	41
„ Adda	..	14	..	..	5	..	..	19
Ras-el-tin Lines	4	15	11	1	6	1	2	40
Fort Ras-el-tin	2	5	21	..	1	..	2	31
„ Saleh Aga	..	4	8	..	..	..	..	12
Battery	..	2	2	..	..	..	..	4
Fort Oom-el-Kubeba	..	6	10	..	1	..	1	18
„ Kamaria	..	2	3	..	1	..	..	6
Meks Sea Lines	4	11	9	..	..	..	..	24
„ Fort	..	4	5	..	3	..	2	14
Total	10	72	100	1	22	1	7	213
	182			31				

Ordnance mounted.

Fort or Battery.	R. guns.	S.B. guns.	Mortars.	Total.
Fort Silsileh	2	3	1	6
„ Pharos	8	37	4	49
„ Adda	5	14	5	24
Ras-el-tin Lines	9	30	10	49
Fort Ras-el-tin	6	28	3	37
„ Saleh Aga	..	12	..	12
Battery	..	4	..	4
Fort Oom-el-Kubeba	2	16	2	20
„ Kamaria	..	5	1	6
Meks Sea Lines	..	24	..	24
„ Fort	5	9	5	19
Total	37	182	31	250

Effects of the Bombardment on the various Forts, &c.

Fort Silsileh.

This work stands at the extremity of a promontory which forms the eastern boundary of the New Harbour, and is connected by a partially ruined causeway with a still more advanced work of no defensive value, styled on the map Pharalion. Fort Silsileh has a semicircular front, and a parapet of considerable height, of which the ditch forms a species of faussebraye. The upper parapet only is armed. (Plate VI.)

The magazine, which is of considerable size, was reported to contain large quantities of gunpowder; it lies underground, and is further, to some extent, covered by a stone tower, which serves as a *réduit* to the fort.

The stores, &c., stand on the left front of the fort, and are entirely exposed to the enemy's fire. They are well stocked with shells, fuzes, &c.

In rear the work is divided from the mainland by a dry ditch, provided with a revetted counterscarp and escarp, the latter of which has a *chemin des rondes*. The ditch is also flanked by a stone caponier, as is also the eastern sea face.

The armament of Fort Silsileh was—

One 9-inch M.L.R. Armstrong gun.

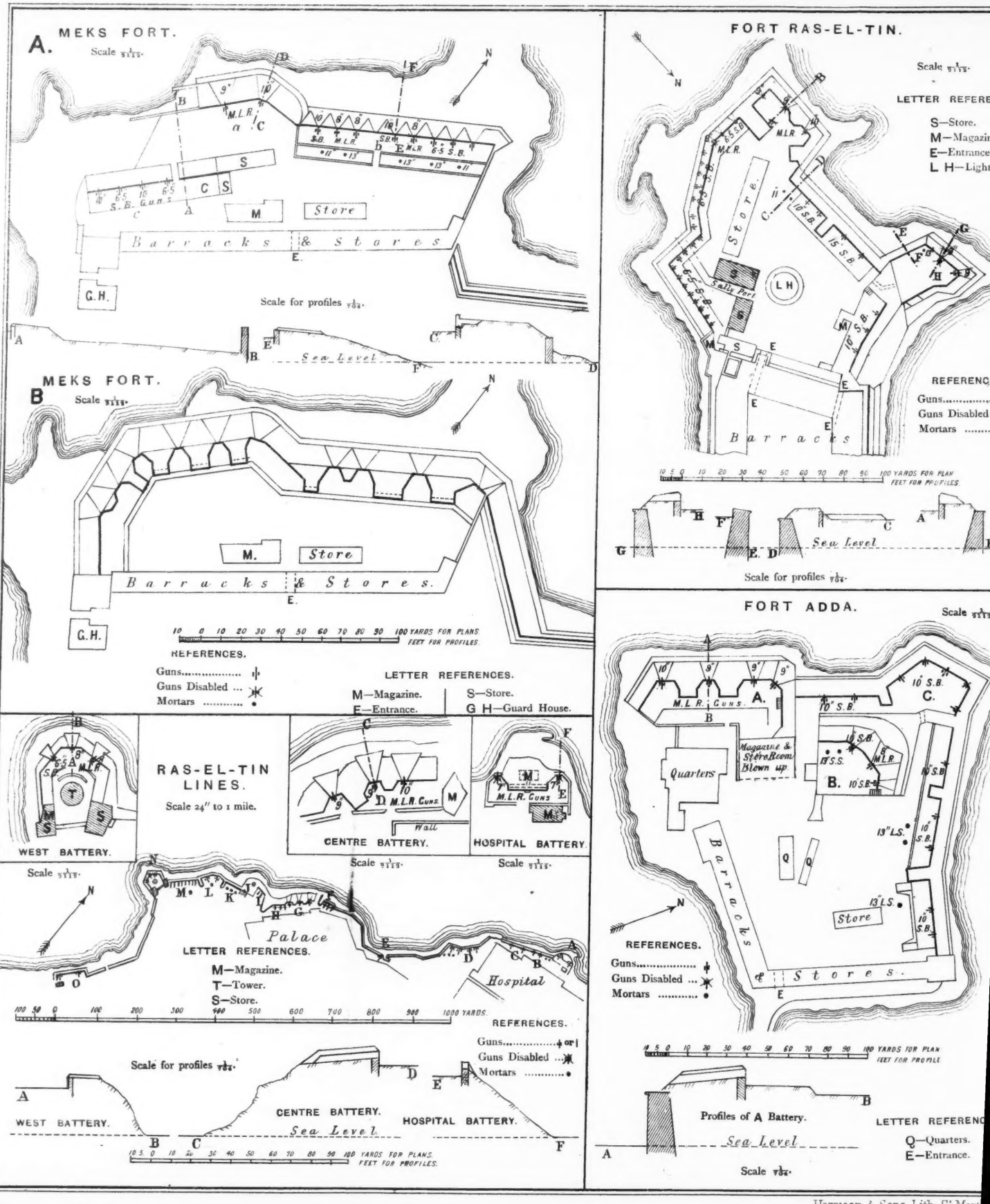
One 8-inch „ „

Three 10-inch S.B. shell guns.

One 13-inch S.S. mortar.

In addition to the above, two 9-inch M.L.R. guns were lying dismounted under the west side of the tower; these were destroyed with gun-cotton by the Navy.

The fire of the "Alexandra" does not appear to have in any way injured the guns or stores of this fort, though fragments of at least



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Scale $\frac{1}{2112}$.

ETTER REFERENCES

S—Store.
M—Magazine.
E—Entrance.
L H—Lighthouse

REFERENCES.

Guns.....
Guns Disabled
Mortars .....

RDS FOR PLAN
T FOR PROFILES.

Scale $\frac{1}{2112}$.

TER REFERENCES.

Q—Quarters.
E—Entrance.

FORT PHAROS OR KAID BEY.

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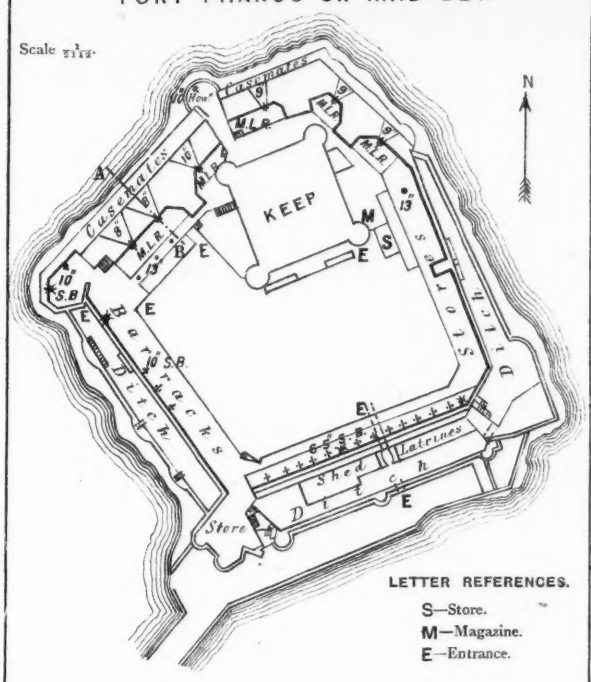


LETTER REFERENCES.

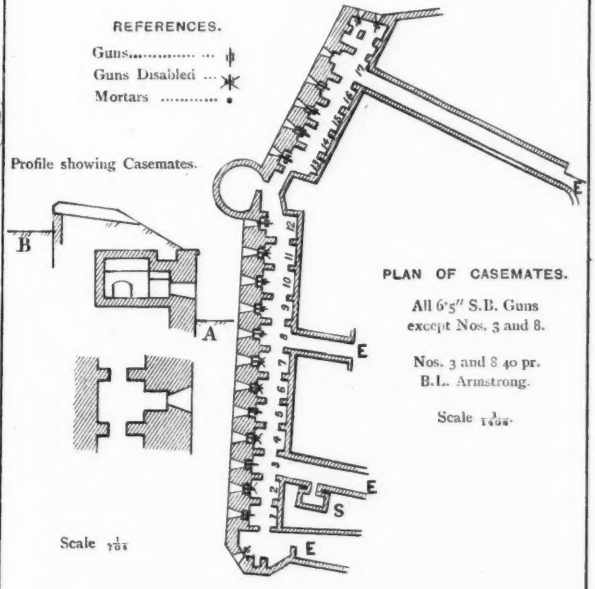
S—Store.
M—Magazine.
E—Entrance.

10 5 0 10 20 30 40 50 60 70 80 90 100 YARDS FOR PLAN. FEET FOR PROFILE

REFERENCES.

Guns.....
Guns Disabled ...
Mortars .....

Profile showing Casemates.



PLAN OF CASEMATES.

All 6·5" S.B. Guns except Nos. 3 and 8.

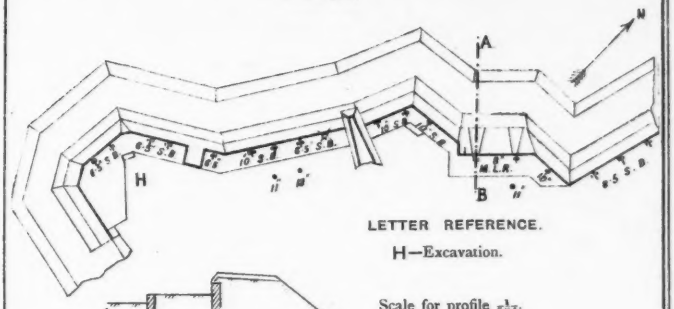
Nos. 3 and 8 40 pr. B.L. Armstrong.

Scale $\frac{1}{1056}$.

Scale $\frac{1}{1056}$.

SEA-FRONT OF FORT OOM-EL-KUBEBA.

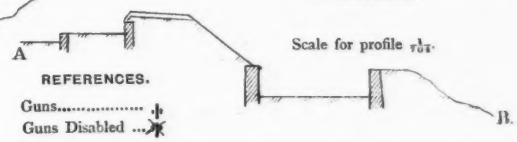
Scale $\frac{1}{2112}$.



LETTER REFERENCE.

H—Excavation.

Scale for profile $\frac{1}{704}$.



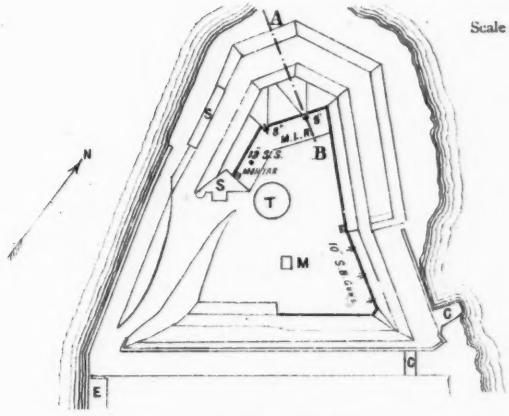
REFERENCES.

Guns.....
Guns Disabled ...
Mortars .....

10 5 0 10 20 30 40 50 60 70 80 90 100 YARDS FOR PLAN. FEET FOR PROFILE.

FORT SILSILEH.

Scale $\frac{1}{2112}$.



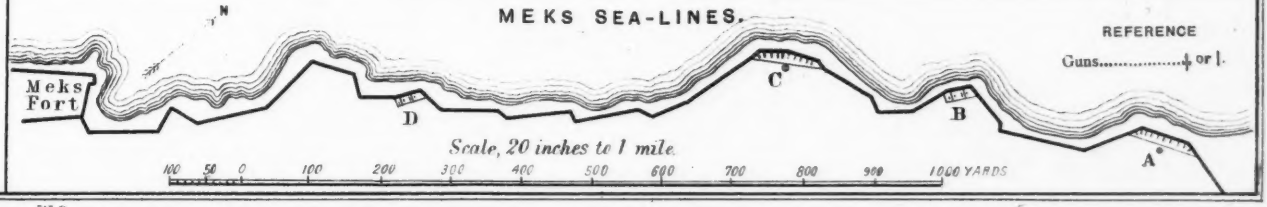
REFERENCE LETTERS.

S—Store. | M—Magazine
T—Tower. | C—Caponnière.
E—Entrance.

Scale for profile $\frac{1}{704}$.

10 5 0 10 20 30 40 50 60 70 80 90 100 YARDS FOR PLAN. FEET FOR PROFILE.

MEKS SEA-LINES.



REFERENCE

Guns.....┼ or |.

Scale, 20 inches to 1 mile.

100 50 0 100 200 300 400 500 600 700 800 900 1000 YARDS

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two shells lie around the rifled guns. In the ditch in rear of the work are two blind 10-inch R. common shell, of which one is fitted with a percussion-fuze, while that of the other has blown out.

Fort Pharos.

This fort, which is named by the Egyptians Kaid Bey (after a Caliph of that name who lived in the fifteenth century), stands at the end of a stone causeway about 500 yards in length, which forms the northern boundary to the New Harbour. This was probably the site of the old Pharos when the above was the only harbour of Alexandria.

Fort Pharos is of various dates; the oldest part of the work is the keep, a massive rectangular stone tower of about 110 feet side, and about 60 feet in height. At each angle stands a round turret, while in the centre of the rear face was a small pharos or light-tower, which was destroyed in the course of the bombardment.

In the keep is a mosque, but the greater part of the building consists of galleries which were used as quarters. Many pieces of old carved alabaster and many granite columns are built into the walls.

The exterior walls to the south and west must also be of considerable age, since they consist of circular towers connected by long curtains, while the old entrance in the south-west corner (marked Store) is a copy in miniature of the gateway of a Norman castle.

Other parts have been built after the introduction of artillery, and others again after guns had come into general use; but of the whole fort no part has at the present day any real defensive value except the battery on the sea front.

This work must be of very recent date, since it is in all ways adapted to modern rifled ordnance.

The parapet is about 22 feet thick, and has a command over the sea level of 40 feet. The escarp has a height to the cordon of 23 feet, and the terreplein of the battery is 12 feet above the parade of the fort.

All the buildings and revetments of the fort are constructed of the stone of which mention has been made, and none of the former have any pretensions to being bombproof.

The magazine is partially protected by the keep, but is entirely above ground; it stands in a part of the fort which was not bombarded by the fleet, but has narrowly escaped a chance shell, which burst on the adjacent turret. At the time of my first visit (about August 1st) the magazine was empty, while in front of it were piled sixty-two barrels which had contained pebble powder.

The casemates which lie under the sea front are of ordinary construction; the thickness of the front wall is 7 feet 10 inches, and the depth of the casemates is 16 feet. There are four entrances (marked "E"), one from the west ditch, and three by covered ramps from the interior of the fort.

The armament of Fort Pharos is given in the following table:—

Position.	M.L.R.			B.L.	S.B. guns.			Mrtrs.	Total.
	10″	9″	8″	40-pr.	10″ H.	10″ L.	6·5″	13″	
Sea front.....	1	3	2	..	..	..	..	3	9
On west tower ..	..	..	..	..	2	..	..	..	2
On west front ..	..	..	..	..	..	4	..	..	4
On rear face....	..	..	..	..	..	..	14	..	14
On east face....	..	..	..	..	..	..	..	1	1
In casemates....	..	..	..	2	..	..	17	..	19
Total.....	1	3	2	2	2	4	31	4	49
	6				37				

Effects of the Bombardment.

The ships appear to have lain on the 11th July in a position due west of the fort, for the west tower and front are breached in many places, and the whole of the west front of the keep, with its two turrets, is in ruins.

The south-east corner of the fort is also much shattered by the shells which have passed over the west front.

The stores and barracks have suffered very severely, and the destruction of so much masonry must have added considerably to the moral effect of the fire of the ships.

With regard to the sea front, the only part of the fort which has any defensive value the parapet, has been hit in several places (seven in all), but in only three cases has a shell entered the battery.

The corners of the traverse to the right of the 8-inch guns have been carried away by two shells, but one of these has done no real damage, while the effects of the second, which has choked the racers of the right-hand 8-inch gun with earth, could be remedied by half-an-hour's work.

A third shell has pierced the sole of the embrasure of the 10-inch M.L.R. gun, and bursting has thrown the large granite block which formed the sill on to the platform of the gun. The *débris* of the embrasure have jammed the trucks on the racers, and the gun is further covered with stones which have fallen from the ruined turret above it. The holdfast of the slide was also carried away, and the gun is out of action.

Not one of the guns,[1] carriages, or slides were in any way injured.

Owing to the position taken up by the bombarding ships the three 9-inch guns were unable to bear on them, and do not appear to have been fired.

Of the S.B. guns, one heavy 10-inch on the west tower has been dismounted, gun and carriage, by a 16-inch shell; one 10-inch shell

[1] It is not proposed to take any notice in this paper of the fact that many of the M.L.R. guns in this and in other forts were burst after the action with gun-cotton charges.

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SHELLS IN PARAPETS.

Fig I. Blind.

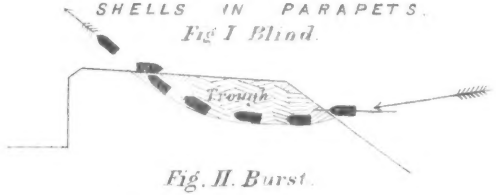
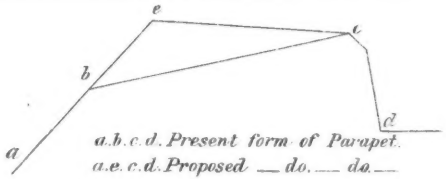
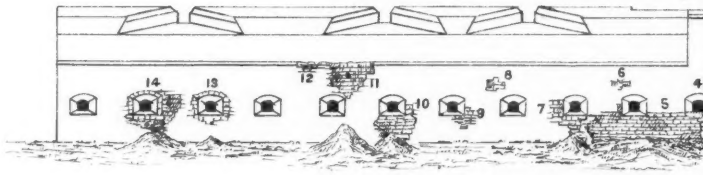


Fig. II. Burst.

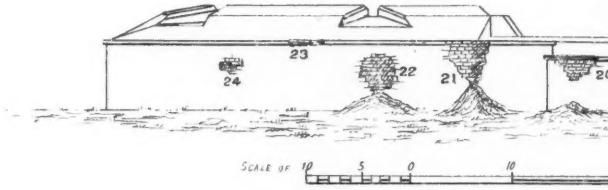


a.b.c.d. Present form of Parapet.
a.e.c.d. Proposed — do. — do.—

Scarp of N. W. face of Fort Pharos.



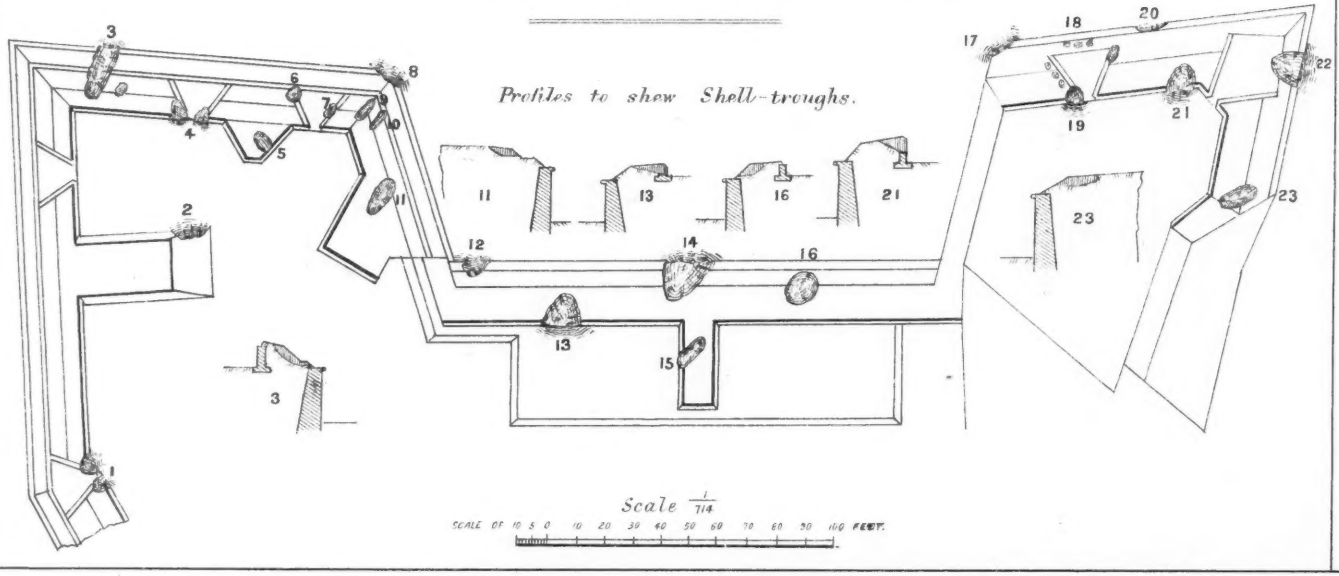
S



EFFECTS OF FIRE ON PARAPETS

Bastioned (W) Front of Fort Ras-el Tin

Profiles to show Shell-troughs.



Scale $\frac{1}{714}$

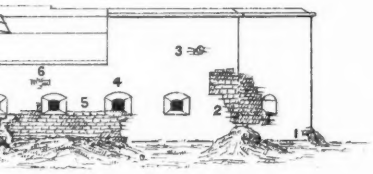
SCALE OF 10 5 0 10 20 30 40 50 60 70 80 90 100 FEET.

Harrison & Sons Lith St. Ma

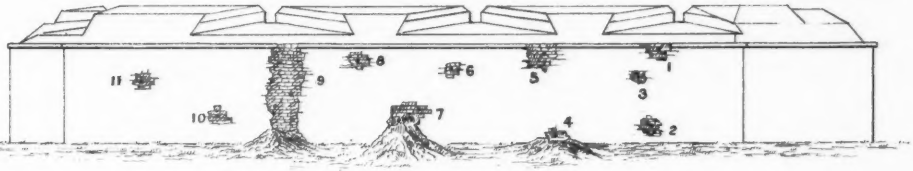
EFFECTS OF FIRE ON REVETMENTS

Scale $\frac{1}{585}$

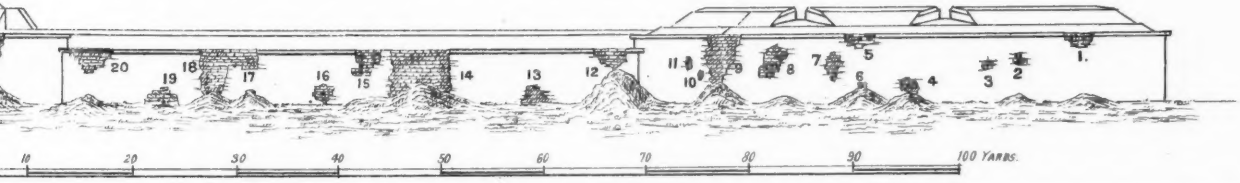
rt Pharos.



Scarp of A. Battery. Fort Adda.

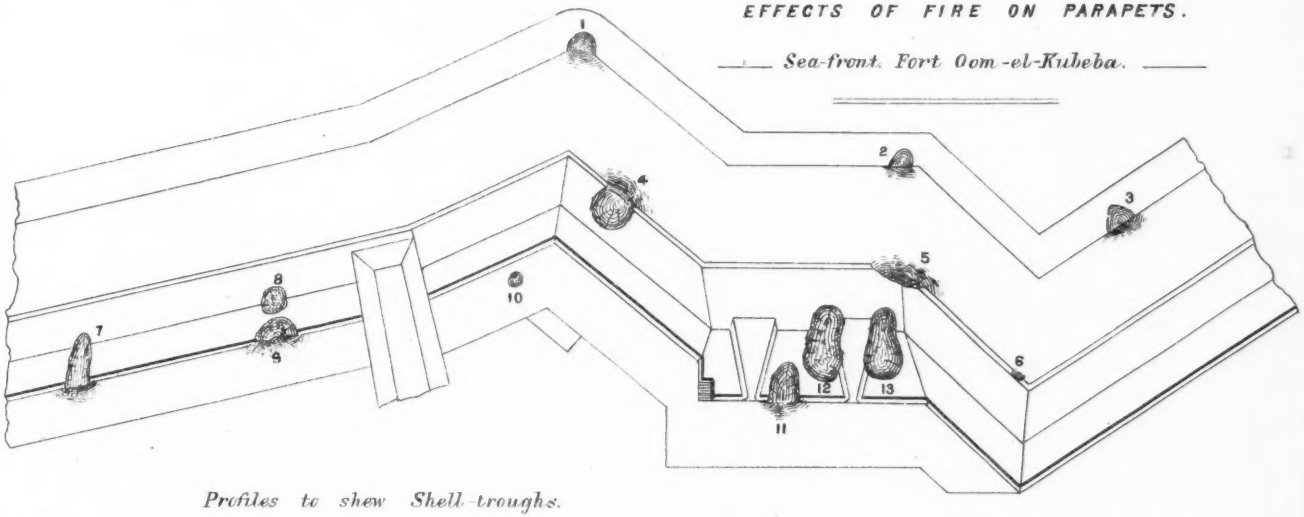


Scarp of Bastioned (W) Front. Fort Ras-el-Tin.



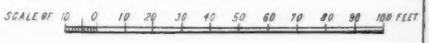
EFFECTS OF FIRE ON PARAPETS.

Sea-front. Fort Oom-el-Kubeba.



Profiles to shew Shell troughs.

Scale $\frac{1}{714}$



Sons Lith St Martins Lane W.C.

gun on the west front has been capsized and put out of action, and it is not unlikely that another, with its carriage, has fallen into the crater formed by a shell.

On the rear face a 36-pounder having been hit on the cascable by a chance shell has been thrown completely over the parapet, and is now, after passing through the roof of a shed in the ditch, standing on its muzzle at a distance of 30 feet from its original position. Another gun is also unserviceable, owing to the partial destruction of its carriage by a shell.

But it is in the casemates that the fire of the ships has inflicted the greatest injury.

The front wall of the casemates is faced with ashlar masonry about 2 feet in thickness, but this course has in many places fallen away under the stress of fire, leaving no further protection to the guns than might be given by about 6 feet of rubble wall of inferior quality; through the latter the heavy shells pierced with ease. The results were as follows:—

Under west tower, casemate penetrated, gun not disabled.

No. 1. Casemate. Carriage blocked with splinters from the embrasure.

„ 2. Gun and carriage utterly wrecked, both being thrown back into the casemate.

„ 3. 40-pr. B.L. Armstrong. Uninjured.

„ 4. Shell has burst under the platform, and ruined gun and carriage.

„ 5. Serviceable.

„ 6. Embrasure beaten in on the gun.

„ 7. Is pierced by two 10-inch Palliser shells. Gun and carriage entirely wrecked.

„ 8. 40-pr. B.L. Armstrong. Serviceable.

„ 9 and 10. Uninjured.

„ 11. Gun and carriage destroyed, and thrown to the back of the casemate.

„ 12. Carriage blocked with splinters from the embrasure.

Of the five casemates on the right sea front No. 17 only, in which there was no gun, has been hit.

All the guns in the casemates (6·5-inch S.B.) were mounted on garrison carriages, which stood on ordinary wooden platforms.

The loss of life in the casemates must have been out of all proportion to the effect produced by the feeble guns which were mounted in them; yet, strange to say, their defenders continued to fight after the rifled battery above had been silenced.

On the escarp of the casemates Nos. 1 to 12 there were about thirteen hits, of which seven pierced the wall.

Fort Adda.

This work, like the preceding, stands on an island, and is connected with the mainland by a causeway about 200 yards in length. It has been of late years partially altered as to its profile, with the object of rendering it more suitable to modern ordnance.

It is, speaking roughly, a fort of four sides, of which the southern and eastern consist of stone buildings, which were used as barracks and stores.

On the southern half of the western side stands a strong cavalier battery (A); it has a command of 40 feet above the sea, and a parapet about 30 feet in thickness, while the scarp, which is revetted, has a height of 28 feet to the cordon. It is divided into three parts by two traverses, in which are expense magazines, while the main magazine and shell-room stood to its right rear.

To the north of the latter stands a second cavalier battery (B), of which the general level is about 12 feet below that of A. Its parapet is 27 feet thick, while the escarp, which is revetted, has a height of 10 feet.

In front of this last work lies a low sea battery (C), which has a command of only 10 feet above the sea, with a thickness of parapet of from 15 to 24 feet.

The parapet which forms the north side of the fort has about the same level and profile as C, and, like the latter, has its guns mounted *en barbette* on traversing platforms.

The guns in A and B Batteries are similarly mounted, but fire through embrasures.

The armament of Fort Adda is given in the following table:—

Position.	M.L.R. guns.			S.B. guns.		13″ mortars.		Total.
	10″	9″	8″	10″ H.	10″ L.	S.S.	L.S.	
A Battery	1	3	..	..	..	..	..	4
B „	..	..	1	..	2	2	..	5
C „	..	..	..	4	3	..	..	7
North front	..	..	..	..	5	..	3	8
Total.....	1	3	1	4	10	2	3	24
	5			14				

Effects of the Bombardment.

The barracks and stores, especially on the east side of the fort, were very much injured by the fire of the fleet, but the batteries were not materially damaged. The only shell which has entered the A Battery is that which, just cutting through the crest, plunged into the magazine and blew it up.

Of the character of this magazine it is impossible now to speak, but since some walls are still standing, it is probable that it was entirely above ground. A shell-store appears to have been in the same building, and was most likely in rear of the magazine, since the shell which it contained have been blown *into* the fort. The loss of life from the explosion was probably very great, as the entire space

between the magazine and the gate is covered with stores, timbers, and broken shell.

The parapet of A Battery has been hit by seven shell, and its escarp by fourteen; the latter is also much marked by shrapnel bullets.

B Battery, on which were two hits, is uninjured, as is also C Battery, which likewise received two shell.

The injury done to the ordnance was as follows:—

The 10-inch Armstrong gun in A Battery has been struck on the muzzle by a shell, but is not materially damaged; a more serious disaster has arisen from the fact that the holdfast of the slide has given way, and the trucks have in consequence left the racers. Thus the gun, though uninjured, is unserviceable; efforts have been made to lift the gun with five lifting-jacks, which are still *in situ*. The other guns are uninjured, except that in one instance the sockets for the running-up levers have given way.

In B Battery a 10-inch S.B. gun has been dismounted by a shell, which has thrown the gun and carriage to a distance of about 15 feet from the slide.

In C Battery, the left, the 10-inch S.B. gun, has been similarly dismounted; while the right gun, a heavy 10-inch S.B., has been struck on the left side of the platform by a shell which has previously cut off the cascable of the second gun to the left; the beams of the platform, about 12 inches in thickness, are completely shattered, and the gun with its carriage is overturned and wrecked.

There can be no doubt but that the defence of this fort could have been easily prolonged had it not been for the explosion of the magazine, which not only must have killed a considerable number of the garrison, but must also have destroyed all the powder in the fort, well as a large proportion of the shells for the M.L.R. guns.

Ras-el-tin Lines.

The right of these works rests, as has been before stated, on a small battery which stands on a bluff point jutting out towards the sea.

This it is proposed to call—

(A.) The Hospital or Bluff Battery.

It was to have consisted of two gun portions divided by a large magazine, but was unfinished at the time of the bombardment: it was, however, to judge by the material on the spot, and the scaffolding erected, in rapid progress towards completion.

The terreplein of the battery has a command of about 50 feet above the sea, which washes the foot of the small hill on which the work stands.

The magazine, which is about 30 feet by 14 feet, is well protected, the thickness over all of that portion of the parapet being 45 feet: on the other hand, the gun portions and the retired flanks of the battery had, on the 11th of July, scarcely any parapet, and the gun detachments were consequently protected (?) from fire by merely a 3-foot wall.

The armament of the battery consisted of two 7-inch M.L.R. Arm-

strong guns, mounted on traversing platforms, and firing through (what would have been) embrasures.

The effects of the bombardment on the battery are, as might be expected, overwhelming: the two gun portions are so entirely destroyed that it is difficult to discover where the original crest has been. The magazine, which appears to have been empty, is untouched, as is also a smaller and older magazine which lies in rear of the battery.

The injuries to the guns are as follows:—

Right Gun.—The cheeks of the embrasure are driven in on the gun, and the trucks are in consequence jammed: otherwise the gun and carriage are uninjured. The former is, however, scored with forty-nine hits from the bullets of a 10-inch shrapnel shell which burst about 30 yards in front of the gun: the greatest depth of any hit was ·5 inch.

Left Gun.—The gun, carriage, and slide are uninjured, but a shell having burst under the front racer on the left side of the gun, has torn it up and bent it into a vertical plane, twisting the truck in its socket, and forcing it off the racer. The slide is also jammed by the ruins of the revetment.

Considering the ruined condition of the battery, the fact that the guns are uninjured is most remarkable, while that they were fit for service is proved by the circumstance that about the middle of August, 1882, they were moved to the position of Ramleh, for the purpose of firing on the enemy's lines.

To the south-west from the Hospital Battery runs a continuous line of works, which stands from 15 to 25 feet above the sea level, and has a parapet from 12 to 24 feet in thickness: it follows the coast round a small bay which lies to the north of the Palace, and thence in a direction parallel to the north wall of the Harem or Children's Palace. At the north-west corner of this wall it joins the centre battery, miscalled the Moncrieff Gun Battery.

This portion of the line (660 yards) contains the following armament:—

B. A battery of two 10-inch S.B. guns.
two 11-inch mortars.

C. Two 10-inch S.B. guns.

D. A battery of four 10-inch S.B. guns.
three 13-inch mortars.

One of the guns is dismounted, and one of the mortars has burst.

E. A single 10-inch S.B. gun.

F. Three 6·5-inch guns.

All these guns are mounted on traversing platforms, and fire over a low parapet.

There is a store for rifled guns in rear of B and of E.

G. The centre battery.

This work possesses considerable strength, the parapet having a thickness of about 32 feet. The escarp is not revetted: the level of the terreplein is about 33 feet above the sea.

The battery is divided into three gun portions by two traverses containing expense magazines.

The armament of the battery consists of—

One 10-inch M.L.R. gun.
Two 9-inch M.L.R. guns.

The guns are mounted on traversing platforms and fire through embrasures, the parapet being about 7 feet 6 inches in height.

Effects of the Bombardment.

Though the parapet is deeply scored in all directions by shells, yet the interior of the battery is almost uninjured; the embrasure of the left gun (9-inch) is, however, choked up by the ruins of the cheeks, while the revetment on each side of the neck has been swept away.

The condition of the guns is as follows:—

10-*inch* (*right gun*).—The right front truck of the carriage has been carried away; the buffers of the slide are much damaged by the recoil of the gun; the masonry of the holdfast has started, and the ties are almost off the pin.

9-*inch* (*centre*).—The gun, carriage, and slide are uninjured, except that the lever of the elevating gear is bent, and the holdfast is rising off the pin.

9-*inch* (*left gun*) has been hit on the left trunnion by a shell which has torn off the capsquare, and also by a second shell on the right bracket 6 inches in rear of the trunnion hole. The gun and carriage are, however, practically uninjured, but the trucks of the slide are jammed by the fall of the revetment, and the holdfast is rising off the pin.

This battery is that which was, in the early reports of the bombardment, miscalled the Moncrieff Battery, but there is in it no one gun mounted on that system. The misnomer probably took its rise from the fact that a gun so mounted stands about 180 yards to the west of the battery.

The intervening space is occupied by—

H. A battery of three 36-prs. S.B.

I. A battery of two 36-prs. S.B.

A large magazine lies under a traverse on each flank of the centre battery.

J. The Moncrieff gun.

This gun, a 9-inch M.L.R. Armstrong, mounted on a Moncrieff carriage, stands alone on a point which projects into the sea. It is neither sunk in the ground, nor covered by a parapet, and standing nearly 12 feet high, offers a conspicuous mark for fire. It was not fired on the day of the bombardment, nor could it be fought in its present condition with any advantage or hope of success.

It was hit on the left side of the carriage by a splinter of a shell, and a bolt in the rear of the left bracket was also cut out by a Nordenfelt bullet. Beyond these it has received no hurt, and is perfectly serviceable.

Passing on to the westward there are in succession—

K. A battery of two 13-inch mortars.
one 12-inch mortar.

L. A bastion containing two 15-inch S.B. guns and one 13-inch mortar.

M. A battery of six 10-inch S.B. guns.
two 36-pr. S.B. guns.

In rear of M. stands a very fine 20-inch mortar.

N. The left (or Harem Battery.)

This work is a small bastion of little defensive power, since it is so cramped, and so entirely devoid of traverses that it is a mere shell-trap.

It has a command over the sea of about 28 feet, and the parapet has a thickness of 13 feet.

In the centre of the work stands a loopholed round tower, to which access is obtained through an underground passage which is entered from one of the stores. Of the latter there are two which stand on the rear face on either side of the gate: there is also a magazine in the left rear of the work.

The armament of this battery consisted of—

Two 8-inch M.L.R. Armstrong guns;

One 36-pr. S.B. gun;

which were all mounted on traversing platforms and fired through embrasures.

The effects of the bombardment on the fort are small, but the loss of life must have been considerable, as many shells have burst in it. The rear face of the tower is in ruins; the shells appear to have burst on meeting the second wall, after piercing the first.

The damage done to the guns is as follows:—

Right Gun (8-inch M.L.R. Armstrong).—A 9-inch Palliser shell, entering through the embrasure, has struck the lower side of the gun; glancing from this, it appears to have burst on the breast of the carriage, with the following results:—The gun, except a dent 8 inches in length on the under surface, is uninjured, but has been thrown about 10 feet from its original position. Both brackets of the carriage are torn away; of these the right bracket lies under the gun, while the left bracket has been blown to the other side of the work, a distance of 22 yards. The entire carriage is a wreck, and the battery is strewed with fragments of angle-iron, &c. The compressor bars of the slide are twisted, the rear transom broken in two, and the rear trucks dislocated, though still on the racers.

Centre Gun (8-inch M.L.R. Armstrong).—The right front truck of the carriage is broken, and the gun is struck by a splinter on the chase. The gun and the carriage have, however, suffered no serious injury, though the left bracket of the latter has been in addition pierced by a splinter.

The 36-pr. is uninjured and was probably not in action.

This little fort, of no great value at the beginning, was probably indefensible at the end of the action.

Between the West Battery and Fort Ras-el-tin, which forms the left pivot of the lines, lies only one battery of two 15-inch guns, the remainder of the parapet being furnished with a banquette for infantry. In rear of the 15-inch battery is a large magazine, underground and in complete safety, but several large stores, which are visible from the sea, have been set on fire by the shells of the fleet.

Close under the north wall of the barrack of Ras-el-tin Fort, and so badly placed that its range is very limited, is an Armstrong B.L. 40-pr. gun, mounted in a very peculiar manner. At first sight nothing is visible but a wooden cover like that of a large well, but on examination it appears that beneath this is a pit, about 30 feet in depth, lined with stone and fitted at the bottom with extensive stores, &c. The gun, which is carried on a naval slide, stands on a platform; the latter is raised by counterweights when the gun is loaded, and after the fire has been delivered is wound down by a windlass, in order that the loading may take place under cover. The wooden roof runs on rails, so that it can be pushed away when the gun comes into action. Every part of the machine seems to be in excellent order, but it does not appear that the gun was in action on July 11. There are in the stores abundance of shells, both common and shrapnel.

The following table gives the total armament of the Ras-el-tin lines:—

Armament of Ras-el-tin Lines.

Positions.	M.L.R. Guns.				B.L. 40-pr.	S.B. Guns.			Mortars.				Total.
	10″	9″	8″	7″		15″	10″	6·5″	20″	13″	12″	11″	
A. Hospital Battery	...	...	...	2	...	...	...	...	...	...	...	...	2
B.	...	...	...	...	...	...	2	...	...	...	...	2	4
C.	...	...	...	...	...	...	2	...	...	...	...	...	2
D.	...	...	...	...	...	...	4	...	...	3	...	...	7
E.	...	...	...	...	...	...	1	...	...	...	...	...	1
F.	...	...	...	...	...	...	...	3	...	...	...	...	3
G. Centre Battery	1	2	...	...	...	...	...	...	...	...	...	...	3
H.	...	...	...	...	...	...	...	3	...	...	...	...	3
I.	...	...	...	...	...	...	...	2	...	...	...	...	2
J. Moncrieff Gun	...	1	...	...	...	...	...	...	...	...	...	...	1
K.	...	...	...	...	...	...	...	...	...	2	1	...	3
L.	...	...	...	...	...	2	...	...	...	1	...	...	3
M.	...	...	...	...	...	...	6	2	1	...	...	...	9
N. Left Battery	...	...	2	...	...	...	...	1	...	...	...	...	3
O.	...	...	...	...	...	2	...	...	...	...	...	...	2
Near Fort Ras-el-tin	...	...	...	...	1	...	...	...	...	...	...	...	1
	1	3	2	2	1	4	15	11	1	6	1	2	49
	8					30			10				

Fort Ras-el-tin.

The plan of this work has been adapted to its somewhat irregular site, but the western front, on which the fire of the fleet was principally directed, has a regular bastioned trace. The right bastion is cut off from the main work by a thick traverse, through which a passage affords an entrance to the battery.

The parapets are exceedingly weak, the average thickness being only about 15 feet, while those of the right bastion are 11 feet, and those of the left bastion about 8 feet only in thickness at the crest.

The scarp has a height of about 19 feet, and the crest a command over the sea of about 28 feet; the former is built of the same stone as the escarps of the other forts, and appears, at least on the west front,

to have a remarkable thickness, since shells which have penetrated it for a distance of 10 or 11 feet have yet not reached the back of the revetment. The south-east front is probably intended only for a saluting battery, since it has but little defensive value.

The parapets do not appear to have been recently strengthened, but there was in the fort a considerable quantity of stone, lime, and sand, which had probably been collected with the object of adding to its strength; while in the right bastion an excavation has been made and a revetment commenced with the apparent object of thickening the right flank, which is at present a 9-foot wall.

The main magazine lies under the front parapet and is exceedingly well covered; it was quite uninjured, but the smaller magazine on the east side of the fort must have narrowly escaped the effects of the shell which destroyed the stores.

Armament of Fort Ras-el-tin.

Positions.	M.L.R. guns.			S.B. guns.			Mortars.		Total.
	10″	9″	8″	15″	10″	6·5″	13″	11″	
North Curtain ..	..	..	..	..	3	..	..	..	3
Right Bastion ..	..	2	..	..	..	..	1	..	3
West Curtain ...	..	..	..	2	2	..	..	2	6
Left Bastion ...	1	2	..	..	..	..	..	..	3
South-east Faces	..	..	1	..	..	21	..	..	22
	1	4	1	2	5	21	1	2	37
	6			28					

The rifled guns and two 6·5-inch S.B. guns (on the south-east face), fired through embrasures, the remainder were *en barbette*. All the guns were mounted on traversing platforms, with the exception of the nineteen 6·5-inch S.B. guns on the south-east faces, which probably merely formed a saluting battery.

Effects of the Bombardment.

The barracks to the north of the fort (which had no defensive value) are riddled with shell and are in many parts in ruins. Between these barracks and the fort communication is carried on by means of two covered ramps (marked E on plan).

The parapets of the fort on the west side are so scored with shell that it is difficult to count or to estimate the number of hits; but, thin as they are, they have at no point been pierced, though several shell, had they hit at more favourable spots, must have made their way through.

The scarp has also suffered severely both at the bastions and the curtain, and is on the right face of the right bastion much marked by

shrapnel bullets. On the west front the parapet shows about twenty-three hits and the scarp twenty-four.

The two S.B. stores (shaded) have been burnt and the rifled shell store is riddled with shell, which have, as a rule, passed through without bursting, owing to the little resistance offered by the very poor masonry.

The lighthouse, which stands in the centre of the fort, has unfortunately been hit by several shell.

The injury sustained by the armament has been entirely confined to the rifled guns, and is as follows:—

In the right bastion—

Right Gun (9-inch).—This gun, though the compressor is on, has run back to the end of the slide, and, breaking the ties, has tilted up on its breech with the muzzle in the air. It is unlikely that this accident was caused by the fire of the fleet, for the keep-pin of the holdfast is broken, and the whole system was evidently greatly strained.

Left Gun (9-inch).—Has been struck by two shell, of which one passed through the crest of the parapet to the left of the embrasure. The gun and carriage are both destroyed. The former has been hit on the left side on the trunnion ring, which is partially torn away; the carriage is in pieces, and the brackets have been torn off and broken. The gun has been thrown about 12 feet to the rear, and has crushed some of the detachment, whose bodies are still beneath it.

In the left bastion—

(i.) 10-*inch M.L.R. Gun.*—Has been hit on the muzzle, but the tube is not damaged. The sockets of the running-up levers are broken by use, and, the tackle having been first shot away and replaced, the shot crane has been broken by a shell, and is useless.

(ii.) 9-*inch M.L.R. Gun.*—This gun has run back and tilted up on the breech in the same manner as the 9-inch gun in the right bastion, but in this case the compressor was not on; the holdfast is not broken, but the keep-pin has carried away, and the bars have drawn off the pin.

It is doubtful whether this result was in any way caused by the fire of the fleet, for though the rear truck of the slide has been hit by a shell, a blow so placed would not be likely to have such an effect, while there is no sign of any other damage to the gun.

South-east face—

8-*inch M.L.R. Gun.*—This gun has been struck in reverse by shells which have passed over the 10-inch gun in the left bastion. The gun and carriage are capsized on the left side, but are uninjured; one truck of the slide has been cut away. The embrasure and parapet in front of the gun have been wrecked, and the gun is now resting on a mass of concrete, which formed the left cheek of the embrasure. This damage was probably caused by three or four successive shells.

On the above-mentioned block of concrete is the print of the head of a Nordenfelt bullet, depth $4\frac{1}{2}$ inches, and the cascable of the gun is also scored by a similar projectile.

It will be evident from the above that Fort Ras-el-tin has suffered

more severely from the bombardment than either Pharos or Adda, since of the rifled guns which could bear upon the fleet, there is not one which can be declared fit for service.

The resistance offered by this fort was probably more prolonged than that of the others, for the reason that it had not before it the example of surrender; again, the magazine was uninjured and safe, nor were there, as in Pharos, masses of useless masonry, whose crashing fall at the impact of every shell added tenfold force to the moral effect of the enemy's fire.

Fort Saleh Aga.

This small and unimportant work stands on the south side of the harbour, at a short distance to the south-west of Alexandria. It consists of an old and weak redoubt, containing a few guns, and some very cramped buildings for stores and barracks; to this has been, at a later date, added a battery of rather better construction, but of no real strength.

The armament consists of—

Four 10-inch S.B. guns, and
Eight 6·5-inch guns;

and the only injury inflicted during the bombardment has been the dismounting of one of the latter.

The fort stands at an elevation of about 60 feet above the sea; in rear of it there is a very large and well-built magazine, which appears to be entirely above ground.

Between Saleh Aga and Oom-el-Kubeba lies a small battery, which is armed with—

Two 10-inch S.B. guns.
Two 6·5-inch do.

Of these one 10-inch S.B. has been dismounted by a shell, which has cut off the right trunnion; while one of the 6·5-inch guns is destroyed though not dismounted, for the breech with the trunnions remains *in situ*, while the chase for a length of 4 feet from the muzzle is lying in *front* of the battery.

It is probable that the latter injury was the result of the bursting of the gun.

Oom-el-Kubeba.

This work, which is about a mile to the west of Saleh Aga, stands on a small hill, the greatest height of which above the sea is about 80 feet.

The sea-front of the work has a good profile, especially in the battery in which the rifled guns are mounted, but the landward faces are merely walls loopholed for musketry.

The entire fort is surrounded by a ditch, which has a revetted escarp and counterscarp, the height of each being about 10 feet on the sea faces; on the land side the counterscarp rises into a wall above the crest of the glacis, while the scarp forms a long curtain of which the crest has a relief of about 30 feet above the bottom of the ditch; the latter being about 15 feet in depth.

The entrance of the fort is on the east side, and is covered by a detached work of masonry. The main fort is divided into two parts by a traverse which extends entirely across it.

The first part is composed of five faces, and has some pretensions to strength, though the interior slope of the parapets is only about 5 feet in height, and there are no traverses.

The second portion of the fort has little defensive value, but is remarkable for the fact that the quarters and stores are all concealed in an excavation,[1] to which access is gained by a stair, while at a depth of about 50 feet below the terreplein are three large halls cut out of the live rock. These halls are partially filled with piles of old bar and chain shot. At the foot of the last stair is a well cut down through the rock, while a supply of water is brought, from what source is not known, into the upper part through a leaden pipe, which runs up the wall of the rear face.

The manner in which the ditch is (or was originally) used as the road into the fort, the means taken to flank it, and the character of the excavated cover, as well as the position of the fort, and the manner of the water supply, all recall very forcibly many of the Mahratta hill forts in the Western Ghauts of India.

The armament of this fort is as follows :—

Two 8-in. M.L.R. guns ;
Ten 6·5-inch guns ;
One 11-inch, and
One 13-inch mortar.

The effects of the bombardment as regards the works are considerable, but their magnitude is due less to the number of hits on the parapet (7) than to the size and weight of the 16-inch shell which caused the majority of the injuries. The effects of three of these shells from the 81-ton guns of the "Inflexible" are well worthy of note. One shell, having burst on the top of the scarp, has by its sole action made an almost practicable breach.

Two others have, within a few feet of each other, hit the parapet in front of the right 8-inch gun, and have almost pierced the 24-foot parapet. They appear to have struck the exterior slope about 4 feet below the exterior crest, and, having cut a trough in the parapet about 11 feet in width, have burst after penetrating 17 feet, and have formed craters 8 feet in radius, and 5 feet and 4 feet 6 inches in depth.

With regard to the ordnance, the only damage which has resulted from the action is the destruction of a 36-pr. S.B. gun. It is difficult to say whether this gun burst on discharge, or was broken by the impact of a heavy shell, but probably the latter was the case. The only parts which remain of it are—the breech, which lies about 30 yards in rear of its platform, and one trunnion with part of the chase, weighing in all about 4 cwt., which has blown a distance of 70 yards, and having just cleared a traverse, is embedded in a soft stone

[1] Marked H in plan.

wall, at a height of about 6 feet from the ground. The two 8-inch Armstrong guns were uninjured.

It is interesting to note that a 10-inch shell (blind) fired by one of the ships is lying in the centre of an arched passage of about 24 feet in length. It is quite impossible to guess how it comes to be in its present position, since the seaward entrance to the passage is covered at a distance of only 8 feet by a high traverse.

Fort Kamaria.

Of this redoubt there is little to say. It has a fairly strong profile, with a revetted scarp; in its trace it is a lunette, and is closed by a defensible barrack.

Its armament consisted of—

Two 10-inch guns S.B.
Four 36-pr. „ „
One 13-inch mortar.

It was untouched by the fire of the fleet, and is believed not to have been engaged on the 11th of July.

Meks Sea Lines.

These lines, which commence about a quarter of a mile to the west of Kamaria, extend along the coast for a distance of 1,800 yards, their left flank resting on Fort Meks. The works form a continued line, which for the most part is a parapet for infantry, of about 12 feet in thickness, but at four points, marked A, B, C, and D, batteries are erected, of which the parapets are from 15 to 18 feet thick.

The scarp is not revetted, and the height of the interior crest does not exceed 4 feet 6 inches above the terreplein.

The guns are mounted on traversing platforms and fire over the parapet, there being no embrasures. The batteries are not provided with traverses.

The armament of the batteries is given in the following table:—

Positions.	S.B. guns.			Total.
	15″	10″	6·5″	
A Battery.....	..	7	3	10
B „	2	..	..	2
C „	..	4	6	10
D „	2	..	..	2
	4	11	9	24

In rear of A and C Batteries stand two stone towers, which serve as stores, magazines, and, being loopholed, if necessary as *réduits*. None of these batteries are much injured by the fire of the fleet, nor do they appear to have taken any very great part in the defence. A 10-inch gun in A Battery has, however, been dismounted by a shell.

Many other guns are at the present moment dismounted, but this would appear to have been done by hand after the bombardment, since these guns show no mark of any damage.

The general height of the line above the sea is about 15 feet, but some portions rise to 20 and 25 feet.

Meks Fort (Plan A).

This work, which has evidently been undergoing alterations, varies very much as to its defensive value in different parts.

(*a.*) The parapet in front of the 9-inch and 10-inch Armstrong guns is 6 feet 6 inches in height, and has a thickness of 35 feet.

(*b.*) That of the right half of the sea battery is about 5 feet in height, and has a thickness of 22 feet, while the low battery

(*c.*) That on the left flank is only 4 feet high and 17 feet thick.

The embrasures in (*a*) have a splay of 60°, and that of the 10-inch gun is countersloping. Whether it is intentionally so made it is difficult to decide, and possibly the real fact may be that the construction of even this part of the work is incomplete. In (*b*) there are nine very shallow embrasures of no great splay; only eight guns are, however, mounted in this portion of the fort. The guns at (*c*) fire *en barbette*.

The gorge of the fort is closed by a line of barracks and stores; these, with the detached stores and the upper magazine, are built of the same soft stone which is used for the other forts.

A second magazine lies underground, beneath the upper, which last is empty. The right flank of the work is closed by a wall, which is provided with a banquette for infantry.

The command of the crest of the parapet of (*a*) above the sea is about 22 feet, and the escarp along the sea-front is revetted to a height of about 13 feet. The escarp of (*b*) battery is not revetted, but slopes down to the sea.

The armament is as follows:—

Positions.	M.L.R. guns.			S.B. guns.		Mortars.		Total.
	10″	9″	8″	10″	6·5″	13″	11″	
Sea battery (*a*).....	1	1	..	..	..	..	..	2
„ (*b*).....	..	..	3	2	3	3	2	13
Left flank battery (*c*)..	..	..	..	2	2	..	..	4
	1	1	3	4	5	3	2	19
	5			9				

To the left of the 9-inch gun, and about 30 yards in front of the left flank battery (*c*), extends a wall about 16 feet high and 3 feet thick; in front of this again is a small fragment of wall, 6 feet in thickness.

Effects of the Bombardment.

The parapets of the fort are practically uninjured, but the buildings are almost swept away. The small store in front of the magazine is laid flat with the ground: a shell bursting inside has levelled the walls, which have fallen in one piece, like those of a house of cards. The large store is riddled with shot, but, strange to say, the magazine is untouched.

The barracks and stores in the rear of the fort are very much damaged: this is above all the case in the neighbourhood of the entrance, which is scarcely distinguishable, being blocked up with ruined wall.

The fort contains many fragments of shell: the loss of life among the defenders was probably considerable.

The damage sustained by the guns is as follows:—

10-*inch M.L.R. Armstrong Gun.*—The gun has been struck on the second coil by a shell which has cut a groove in the metal of an oval shape, 11 inches long, 6½ wide, and 1 inch deep: the coil is shaken out of place, and cracked, but the gun is still serviceable.

A Nordenfelt bullet has hit this gun obliquely 18 inches in front of the trunnion, and has penetrated 1·25 inch, and a shell has also burst under the rear of the left trunnion, but has done no damage.

It is impossible to state, as regards either this or the succeeding gun, what injury was caused by the fire of the fleet to their carriages or platforms, since all have been entirely destroyed by the gun-cotton charges which were used by the landing party on July 11th, for the purpose of dismounting the guns.

9-*inch M.L.R. Gun.*—The gun has been struck by a shell on the right side of the breech, and has received an oval graze 12 inches in length, 7 inches in breadth, and 1·25 inch deep.

In the right portion of the sea battery the three guns on the left, a 10-inch S.B. and two 8-inch M.L.R. guns, have been hit by from nine to twelve shrapnel bullets, while the fifth gun from the left, an 8-inch Armstrong, has been struck on the second coil by a shell which seems to have come in over the parapet.

The blow has dismounted gun, carriage, and slide, and has thrown the first a distance of 3 yards. The metal of the gun is ripped off at the point hit for a length of 18 inches, and the trunnion ring is also started by the force of the blow. There is on the left of the breech the mark of a Nordenfelt bullet—depth ·55 inch.

The carriage and slide though upset are not damaged with the exception that the bars of the compressor are bent.

The remaining guns in this battery, 36-prs., are uninjured.

Left Flank Battery.—The action of these guns is worthy of note, for it was said by an eye-witness of the bombardment, who was on board of the "Invincible" on the 11th July, that they were much annoyed by the fire of two 10-inch S.B. guns, which appeared to be protected, either in a Moncrieff pit or in some other way, since it was found very difficult to silence them.

It appears not unlikely that *these* were the 10-inch guns in question,

and that their comparative safety was due to the existence in their front of the wall of which mention has been made, and which at the top is about 6 inches below the level of the crest of the parapet.

This wall, though sufficiently low to allow of the fire of the guns on the ships, was yet high enough to burst (it was too weak to stop) many shells which might otherwise have hit the battery, while those projectiles which cleared the wall for the most part flew over the guns. The shattered condition of the wall, and the fact that the battery was almost untouched, appear to have proved that this suggestion has in it some little truth.

The effects of the bombardment on the guns in the left flank battery are as follows:—

Left Gun (10-inch S.B.).—This gun has been hit on the right of the carriage by a splinter, and near it are lying many fragments of a 64-pr. common shell: it was uninjured.

No. 3 Gun (10-inch S.B.).—This has been hit by a shell on the muzzle, and the carriage has been struck by thirteen shrapnel bullets; both gun and carriage are undamaged. The two remaining guns in the battery are 6·5-inch S.B. guns; they are both untouched.

At the gate of the fort four 9-inch and one 10-inch M.L.R. guns lie on skids, while a second 10-inch Armstrong gun lies in front of the magazine. Inside of the fort are two 10-inch and eight 9-inch carriages and slides, while in the bastion to the west of the fort were four more 9-inch M.L.R. Armstrong guns.

Plan B.

On the 14th of August, 1882, a plan drawn by some Egyptian engineer was found in one of the arched exits from the Meks land lines.

This gives distinctly, as shown in Plan B, the trace of the proposed improvements which were to have been made in Fort Meks.

The parapet was to have been continued on the left up to the barracks, and on the right to the sea line, and was further to have been strengthened along the whole front. The terreplein was to have been protected by traverses containing expense magazines, and little doubt can exist but that the six M.L.R. guns which were lying in and near the fort would have been mounted at the new embrasures.

No one who examines the two plans can fail to see how very much these changes would have added to the defensive and offensive value of Meks Fort, which, as shown in Plan B, would have been in trace and armament the strongest of the Egyptian forts.

From one drawback this work must always have suffered—namely, the small elevation of its parapet above the level of the sea, but a few more weeks of labour would have made, of what was in fact a weak and broken line, a strong fort strongly armed.

Forts to the West of Meks.

Marsa-el-Kanat is a small fort of no defensive power, which stands about 3,000 yards to the west of Meks Fort.

Its armament consists of—

Two 10-inch S.B. guns.
Two 6·5 „ „

A few shells were, on the 11th of July, thrown at this work by the "Monarch," but no injury was done to the fort, though a shell exploded a small store of gun-cotton (intended for use in the quarries) which stood near it.

Fort Ajami is unfinished, and took no part in the defence.

Fort Marabout stands on an island about 3 miles from Meks Fort. It was attacked on the 11th of July by some of the gunboats, with the result that a small store has been burnt, while the scarp has received several hits, but none of the guns have been in any way injured.

The armament is—

Three 9-inch M.L.R. Armstrong guns.
Two 10-inch „ „ „ } Unmounted.
Two 9-inch „ „ „ }
One 7-inch „ „ „ }
Eight 10-inch S.B. guns.
Seventeen 6·5-inch S.B. guns.
Two 13-inch mortars.
Five 11-inch „

Meks Land Lines and Citadel.

The works which, commencing at Fort Meks on the north, run almost due south to within 300 yards of Lake Mariout may be styled the Meks land lines; they consist of a continued chain of bastions and curtains about 1,300 yards in length.

The lines have a good profile, a revetted escarp and counterscarp, and a wet ditch which communicates to the sea. Their relief is about 30 feet, and their command over the adjacent country about 15 feet.

The armament consists of a considerable number of guns, but since these lines were not included in the bombardment, details on the subject would be beyond the scope of this paper.

Two guns, however, which are mounted on the large bastion to the south-west of the citadel, are worthy of note.

The first of these is a gun of about 80 cwt., which is marked "Ruelle, 1833." This has been bored out by Armstrong, and, being lined with a steel tube, has now a calibre of 6 inches; the tube, which projects about a foot beyond the muzzle, has five grooves. The second was originally one of the 15-inch S.B. guns of which mention has been made before. It has also been bored out and lined by Armstrong, and has now a calibre of 8 inches, and four grooves.

The Citadel of Meks, or Fort Namusia, is an oblong masonry work, about 150 yards in length by 70 in breadth.

Its scarp has been cut down vertically from the foot of the walls through the live rock, in which is excavated a ditch, about 60 feet in width, and 30 in depth, with a vertical counterscarp.

The entrance is at the east end, and is accessible over a wooden bridge, of which part is a drawbridge.

This fort has little real power against modern artillery, and is mentioned only because from it the fire of some 40-pr. Armstrongs and 36-pr. S.B. gave some annoyance to the ships which were bombarding Fort Meks. It was found difficult to silence these guns, both on account of the distance of the fort from the sea, and also because since the ground rises to the south of Fort Meks the citadel stands about 60 feet above the shore.

Large numbers of torpedoes and torpedo-weights were found in this work and in the adjacent bastion.

I have endeavoured in the paper which I have just read to lay before you, as far as the time at our disposal will permit, the general effects of the bombardment of Alexandria, and I have, to the best of my ability, while so doing, avoided any expression of my own opinion upon any point, and also any attempt at deduction from the facts which I have had the honour to bring to your notice. I shall, however, hope, with the permission of the Council, to examine next Wednesday more particularly into the many points of the attack and defence which appear to promise interest or information.

I have to offer my most sincere thanks to Commander May, R.N., for his kindness in aiding me with the details of many important facts, of which, from my own knowledge, I could not have written.

I have also to thank Captain Clarke, R.E., with whom I worked at Alexandria, for the use of the drawings and notes which we made there, and must further acknowledge the kind assistance of Lieutenant-Colonel Tulloch.

Wednesday, February 21, 1883.

FIELD-MARSHAL H.R.H. THE DUKE OF CAMBRIDGE, K.G., G.C.B., &c., &c., &c., President of the Institution, in the Chair.

PART II.

YOUR ROYAL HIGHNESS, LADIES AND GENTLEMEN,

IN the paper which I read last Friday I endeavoured to describe, with as much detail as the time at our disposal would permit, the effects of the fire of the fleet on each individual fort.

I now propose to examine into the character of the bombardment as a whole, with reference to both ships and forts, and to endeavour to bring to your notice such points in the attack and defence as appear to be most worthy of remark, and such failings in the works and armament of the Egyptians as are most replete with warning to all nations which need coast defences.

In order to avoid the constant repetition of apologies for venturing thus to put forward my opinions before an audience far better qualified

than myself to judge of the value of the details which I have given, I should wish once for all to say that, though, for the sake of brevity, my deductions may be presented in a manner which may appear didactic, I am in fact desirous only to offer for discussion such points as, at various times during the execution of my work, have attracted my notice, as being capable of affording interest or information.

General Action, &c., of the Fleet.

The inshore squadron, assisted by the "Temeraire," as was mentioned in my last paper, devoted its attention to Meks Fort and Lines. Of these the "Invincible" and the "Penelope" were anchored, while the "Monarch" was under way.

Concerning the action of this portion of the fleet there is little to observe, except to say that their work was most efficiently done; no one who visited Meks Fort after the bombardment could doubt but that the fire had been exceedingly severe, since, apart from the destruction of the stores and barracks, there was only one gun (if we omit the 6·5″ guns which were probably not in action) which had not been hit by some missile.

The action of the larger ships which composed the outside squadron is full of interest to those who may be called upon to defend coast batteries.

In the many conversations which I have had at various times with Officers of the Navy on the subject of the attack of forts by a fleet, I have always been led to believe that the mode of attack in such a case would be as follows: The ships, formed in line ahead, would steam past the batteries, each ship delivering her fire as her guns in succession would bear. Having thus passed the line of defences, the ships would turn and repeat the process with the other broadside.

I have been given to understand that by this manœuvre the forts, which have the advantage of a fixed gun-carriage, would suffer from the disadvantage of a moving target.

On this principle for two and a-half hours (from 7 to 9.30) the bombardment of the forts, from Ras-el-tin to Pharos, appears to have been conducted by the "Alexandra," the "Superb," and the "Sultan."

Since at 9.30 this mode of attack was changed for one which consisted of the systematic concentration of fire on individual forts from ships more or less stationary, we may perhaps conclude that the former plan was found faulty.

I am further confirmed in my belief that the best principle in practice is the consecutive silencing of individual batteries, and not a general and, so to speak, collective bombardment, by the testimony of an eye-witness, who informed me that from the time of the adoption of the second plan the fire of the ships improved very much in accuracy.

From another source I received a corroboration of this fact, to which my informant further attributed a simultaneous diminution in the accuracy of the fire of the enemy, and I venture to say, under correction, but on good authority, that the majority of the shells which hit the "Superb," the "Alexandra," and the "Sultan" were

received by them before 9.30, that is to say, during the first two and a-half hours of the eight hours of action.

Probable Conduct of Future Bombardments.—From these statements I draw the conclusion that in future bombardments it is probable that ships will attack forts at a range beyond the armour-piercing power of ordinary projectiles, but from a more or less stationary position, and will thus abandon the advantage conferred upon them by their power to refuse a fixed target to their adversaries.

The ships will, however, of course, still possess, and make use of, every facility to change their posts whenever the forts may find their range.

But I would suggest that ships, by thus abandoning their former practice of engaging under way, not only surrender one of the principal advantages which they possess over forts with a fixed position, but further render themselves liable to suffer from vertical fire, which, if once accuracy of range can be obtained, must be most formidable, when directed against the small but comparatively weak targets which are offered by the decks of stationary ships. It would appear probable that, so long as ships are in motion, there is much chance that their fire, though severe, may not be decisive; it is therefore to the interest of the garrisons of the forts to keep them under way, and this object may be attained by directing upon them a bouquet of large shells as soon as they take up a stationary position. If this action were persistently and efficiently pursued, no ship could with impunity either anchor or remain motionless, except at an extreme range. Again, the nature of a contest between ships and forts is such, that any result short of a decisive success for the former, is a victory for the latter, and it is therefore necessary, as a condition of such success, that the fire of the fleet should be, not merely heavy, but overwhelming in its superiority.

May we not further reason, this being the case, and it being further found in practice that ships in motion cannot crush coast batteries, that forts which can by whatever means compel ships to keep under way, have *primâ facie* an advantage over the latter?

In other words, the benefit which is gained by the moving target is more than cancelled by the moving gun-carriage, and ships which intend to successfully engage forts must be content to become for a time mere floating batteries.

Result of the Fall of a Gun on Board Ship.—Another point, suggested by an Officer of the Navy, is, I think, worthy of our attention. We have seen how in Fort Ras-el-tin a 12-ton 9-inch gun was, by the burst of a shell, thrown from its carriage to a distance of 10 or 12 feet.

What would have been the result had this casualty occurred on board ship? It is of course unlikely that it should occur in the battery of an ironclad, since such an accident would probably imply that the shell had entered through the port. But no one can deny but that such a thing may happen,[1] and it is thus surely necessary to make some provision with regard to so important a matter.

[1] On the 11th of July a shell entered a port of the "Penelope" and put an 8-inch gun out of action.

It is probably not too much to conclude that a gun of such weight falling as it probably would from a height of 5 or 6 feet, would be almost certain to burst its way through the deck, and might not impossibly inflict such damage on the framework or skin of the ship, which is not constructed to resist a blow from the interior, as would result, if not in total loss, at any rate in retirement from the action.

Such an injury would be caused only by a large shell; the action of a small projectile would probably tend to blow away the brackets of the carriage, in which case the gun would fall on the slide with the minimum of damage. Examples of similar action may be observed in Meks Fort, where this result has followed the explosion under the gun of small charges of gun-cotton.

With the suggestion of these two points for discussion, I propose, since our time is limited, to pass from the question of the reciprocal action of ships and forts, and to return to the subject of the paper.

Character of the Fire of the Ships.—If we examine into the character of the fire of the outside squadron, we shall find that in direction it was remarkably accurate.

Of this the best proof is given by the comparison of the condition of the walls, buildings, &c., which lay immediately behind the guns which were in action, with other portions of the forts and batteries, which lay a short distance out of the line of fire. The centre battery in Ras-el-tin lines offers a good example of this statement, since the wall in rear is pierced through and through in the immediate neighbourhood of the work, and is almost uninjured throughout the remainder of its length.

But the elevation of the guns, as might be anticipated, was not so good, for appearances lead to the belief that the fire was in general too high; in proof of this fact may be mentioned the number of hits on the Pharos keep, and on the lighthouse at Fort Ras-el-tin, as also the fact that more shells have fallen on the buildings of the forts after passing over the parapets, than have struck the parapets themselves or the scarps.

Speaking roughly of the shot which have hit the forts, 50 per cent. have passed over the parapet, 33 per cent. have struck the escarp, and about 17 per cent. the parapet.

For this effect there may have been several causes; first, the extreme difficulty, on account of smoke and mist, which was experienced in seeing the guns or embrasures; second, the natural tendency to fire at conspicuous objects such as towers or flagstaffs; and, third, the inclination, which always shows itself in hurried firing, to take too full a sight.

To these may be added the apparently great effect of shells, which, falling on masonry, sent up a cloud of dust, as compared with that of such projectiles as cut their way through the crest without a sign: since thus the visible result of a shot, which was in truth by no means deadly, may have led to the retention of the elevation with which that shot was fired in preference to that of one which had produced no obvious effect.

From a careful examination of the parapets, I am led to believe

that the most effective shots were probably those least likely to attract observation.

Blind Shell.—With regard to the number of blind shells, as to which there has been some discussion, the number seen on the entire line may be roughly estimated at about 50; of these about 66 per cent. were Palliser and 33 per cent. common shell. No blind shrapnel were observed. The small resistance offered by the bad masonry and by the yielding sand may possibly account for some of these failures:[1] in other cases the point of the shell, and with it the fuze, has been as it were ground off on impact; and a few fuzes seem to have blown without igniting the charge.

In the west ditch of Pharos lie two 10-inch common shell, of which the appearance is most remarkable: they have broken transversely across; the base of each is still full of powder, while the serge of the bag is almost white; facts which prove conclusively that the fractures are not the result of explosion.

To account for this condition of the shells, I would suggest that, the axis of each projectile having been during flight inclined to the horizon, it has, in falling, struck an angle of the masonry, not with its point but with its side, and has thus been broken transversely.

Machine-Guns.—A few words must be said as to the action of the machine-guns (Gatling and Nordenfelt), of the effect of which much mention was made in the newspapers. It having been stated that in many cases the gun detachments had been driven from their guns by the fire of the above weapons, especial care was taken to examine every piece of ordnance in the defences for the marks of such fire, on the principle that, if the gunners were hit, the gun itself could certainly not escape untouched.

With regard to the Gatling guns (which fired during the action 7,100 rounds), it will be sufficient to say that, after a most careful search in all the forts and batteries, no sign whatever could be found of their effect.

Of the shot of the Nordenfelt guns (which fired 16,233 rounds) 5 marks were found.

These were as follows:—

(i.) A deep (4·5″) print of the head of a shot on a concrete block, which had fallen from the embrasure of the 8-inch M.L.R. gun in Fort Ras-el-tin.

(ii.) A mark on the cascable of the above gun.

(iii.) A dent on the left bracket of the Moncrieff gun.

(iv.) An oblique hit, 1·25 inches in depth, on the 10-inch M.L.R. gun in Meks Fort.

(v.) A hit, ·55 inch in depth, on that 8-inch M.L.R. gun in Fort Meks which was dismounted by a shell.

There were no visible marks of projectiles from either of these weapons on any of the scarps or parapets, but it was reported that a

[1] The percussion fuzes used during the bombardment were, as was customary for sea service, designedly constructed in such a manner that they were not liable to act on graze, but only on direct impact.

considerable number of Nordenfelt bullets were picked up in Fort Meks.

The effects of shrapnel were far more frequent and more marked than those of either of the machine-guns.

The Hits received, the Losses suffered, and the Ammunition expended by the Fleet.

Hits.—The hits received by the fleet during the bombardment were as follows:—

"*Alexandra.*"—24 shot and shell penetrated the ship above the armour-plating; among other injuries the cabins of the Admiral, the Captain, the Commander, the Staff-Commander, and the Torpedo-Lieutenant were all damaged.

Several shot and shell struck the armour; of these one, which fell on the upper edge, made indentations on the plate of from ·5 inch to 1 inch in depth.

The foremost funnel was hit in 3 places, the standing rigging in 8, and the running rigging in 21 places.

The total number of hits was thus about 60.

The losses were 1 killed and 3 wounded.

"*Sultan.*"—The number of hits is not exactly detailed, but is reported to have been about 27, of which 2 struck the armour, denting 2 plates and starting 1.

The holes made in the side were as follows:—

(*a.*) 16 inches by 12 inches; (*b.*) 15 inches in diameter; (*c.*) 14 inches in diameter.

The rigging was cut in several places, and a hole 16 inches by 10 inches made through the mainmast.

The losses were 2 killed and 8 wounded.

"*Superb.*"—14 hits, of which 7 were on the hull, and 7 on the upper works and spars.

A 10-inch shell struck the port-side, and, bursting, tore a hole in the side 10 feet by 4 feet, within 3 feet of the water-line.

The armour-plates on the port side were struck with 2 shells, of which—

(i.) Indented the armour 3 inches, while

(ii.) Burst, starting the plate and breaking 14 rivet heads.

Some of the standing and running rigging was shot away, and a hole 12 inches in diameter was made in the foremast.

Two other holes in the side were as follows:—

(*a.*) 10 inches in diameter, 4 feet above water-line.

(*b.*) 12 inches in diameter (10-inch shot), 5 feet above water-line.

The losses were 1 killed and 1 wounded.

"*Penelope.*"—Received 8 hits, of which 3 were on the armour; these left little or no indentation. Of the others—

(i.) Passed through the after embrasure, starboard side, but did no special damage.

(ii.) Hit the starboard quarter gallery.

(iii.) Struck the starboard gangway, hit a 9-pr. gun, carried off the sight and damaged the carriage.

(iv.) Hit the mainyard, port side.

(v.) Struck the muzzle of one of the 8-inch guns, stripped the B-tube for 6 inches off the A-tube, then broke up and destroyed the transom plate of the carriage. The gun and carriage were put out of action, and 8[1] (or 10) men were wounded. Some of the rigging was shot away.

The losses were 8 (or 10) men wounded.

"*Invincible.*"—The exact number of hits is not given in the report, but it appears to have been about 11, 6 of which passed through the side.

A large dent was made in the armour by a shot, which also started the plate.

The losses were 6 wounded.

"*Inflexible.*"—No definite return can be obtained of the hits on this ship. Their number is reported to have been 6, but of their effect nothing can be stated beyond the fact, "that the armour-plating was not struck, and that such projectiles as took effect struck or exploded outside the citadel."[2]

"No serious injury was done, though the upper works were a good deal knocked about."[3]

The losses were 1 killed and 2 wounded.

"*Monarch*" and "*Temeraire.*"—Received no hits and suffered no losses.

The gunboats appear to have also entirely escaped injury.

Losses.

Table of Losses.

Ship.	Killed.	Wounded.	Total.
"Alexandra"	1	3	4
"Superb".....	1	1	2
"Sultan".....	2	8	10
"Inflexible"	1	2	3
"Invincible"	..	6	6
"Penelope".....	..	8	8
Total.....	5	28	33

Expenditure of Ammunition.—The expenditure of ammunition by the Fleet is given in the following tables, which are compiled from the official report:—

[1] The report of the Captain of the "Penelope" states that 10 men were wounded by this shot, but the General Return gives only 8 names.

[2] Report of Captain, August 7, 1882.

[3] Admiral's despatch, July 20, 1882.

Expenditure of Ammunition.—Filled Cartridges.

Ship.	Gun.																		Total lbs.
	16″	12″	11″		10″		9″		8″		7″		64-pr.		40-pr.	20-pr.	9-pr.	7-pr.	
	lbs. 450	lbs. 55	lbs. 85	lbs. 60	lbs. 70	lbs. 44	lbs. 50	lbs. 30	lbs. 35	lbs. 20	lbs. 14	lbs. 10	lbs. 10	lbs. 8	lbs. 5	lbs. 2¼	lbs.ozs. 1 12	ozs. 12	
"Alexandra"	..	..	47	1	223	..	..	..	..	..	..	..	..	..	..	138	..	..	20,010
"Sultan"	..	..	..	..	16	121	20	30	..	..	..	..	..	..	..	140	..	14	8,704·5
"Superb"	..	..	..	..	312	19	..	..	..	..	..	..	..	..	..	60	41	..	22,897·75
"Penelope"	..	..	..	..	..	..	..	..	39	192	..	..	..	..	96	23	30	..	5,795
"Monarch"	..	121	..	..	..	..	2	50	..	..	20	..	..	..	..	..	157	32	8,833·75
"Temeraire"	..	..	81	55	70	14	..	..	..	..	..	..	..	..	..	..	..	..	15,701
"Invincible"	..	..	..	..	..	..	2	129	..	..	..	..	..	110	..	22	..	..	4,905
"Inflexible"	88	..	..	..	..	..	..	..	..	..	..	..	..	..	..	120	..	..	39,900
"Beacon"	..	..	..	..	..	..	..	..	..	..	26	..	20	2	..	53	..	..	712·5
"Condor"	..	..	..	..	..	..	..	..	..	..	65	..	128	..	..	..	..	8	2,196
"Bittern"	..	..	..	..	..	..	..	..	..	..	33	..	..	..	56	..	..	..	742
"Cygnet"	..	..	..	..	..	..	..	..	..	..	..	..	..	101	..	42	..	..	913
"Decoy"	..	..	..	..	..	..	..	..	..	..	..	..	49	..	..	20	..	..	540
"Helicon"	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6	..	..	15
Total	88	121	128	56	621	154	24	209	39	192	144	..	197	213	152	624	228	54	131,865·5

Expenditure of Ammunition.—Shot and Shell.

Ship.	Gun.							Total heavy guns.	Gun.					Grand Total.	Martini-Henry.	Nordenfelt.	Gatling.	Rockets.
	16″	12″	11″	10″	9″	8″	7″		64-pr.	40-pr.	20-pr.	9-pr.	7-pr.					
"Alexandra"	..	..	48	221	..	..	..	269	..	..	138	..	..	407	..	4,000	340	..
"Sultan"...	..	..	..	137	50	..	..	187	..	..	139	..	12	338	..	1,800	2,000	..
"Superb"..	..	..	..	310	..	..	..	310	..	..	60	41	..	411	..	1,161	880	..
"Penelope".	..	..	..	..	..	231	..	231	..	96	23	30	..	380	5,000	1,672	..	..
"Monarch".	..	117	..	..	48	..	21	186	..	..	..	153	28	367	1,800	3,440	2,680	21
"Temeraire"	..	..	136	84	..	..	..	220	..	..	8	..	..	228	..	160	..	..
"Invincible"	..	..	..	..	126	..	..	126	106	..	18	..	..	250	2,000	2,000	1,000	..
"Inflexible"	88	..	..	..	..	..	..	88	..	..	120	..	..	208	..	2,000	..	..
"Beacon"..	..	..	..	..	..	..	16	16	22	..	53	..	10	101	320	..	..	3
"Condor"..	..	..	..	..	..	..	65	65	128	..	..	..	8	201	1,000	..	200	13
"Bittern"..	..	..	..	..	..	..	33	33	..	56	..	..	..	89	..	..	..	..
"Cygnet"..	..	..	..	..	..	..	..	..	101	..	42	..	..	143	..	..	..	..
"Decoy"...	..	..	..	..	..	..	..	..	49	..	20	..	..	69	40	..	..	..
"Helicon"..	..	..	..	..	..	..	..	..	6	..	..	..	..	6	..	..	..	..
Total...	88	117	184	752	224	231	135	1,731	412	152	621	224	58	3,198	10,160	16,233	7,100	37

Character of Projectiles Fired.

Ship.	Filled Shell.				Empty Shell.	Shot.	Case.	Total.
	Common.	Palliser.	Shrapnel.	Segment.				
"Alexandra"	379	23	1	..	..	4	..	407
"Sultan"	247	24	3	44	10	10	..	338
"Superb"	257	83	25	34	..	12	..	411
"Penelope"	241	..	45	32	..	62	..	380
"Monarch"	227	5	129	..	..	6	..	367
"Temeraire"	139	70	13	6	..	..	..	228
"Invincible"	221	..	25	..	2	2	..	250
"Inflexible"	139	21	11	37	..	..	..	208
"Beacon"	21	..	..	1	61	18	..	101
"Condor"	162	..	8	..	31	..	..	201
"Bittern"	66	7	1	..	..	12	3	89
"Cygnet"	72	..	..	..	71	..	..	143
"Decoy"	69	..	..	..	..	..	..	69
"Helicon"	6	..	..	..	..	..	..	6
Total	2,246 or 70 per cent.	233 or 7 per cent.	261 or 8 per cent.	154 or 5 per cent.	175 or 5·5 per cent.	126 or 4·5 per cent.	3	3,198

Average Number of Rounds per Heavy Gun.

Ship.	Gun.							General Average.
	16″	12″	11″	10″	9″	8″	7″	
"Alexandra"	..	..	24	22·1	..	..	..	22·4
"Sultan"	..	..	..	17·12	12·5	..	..	15·5
"Superb"	..	..	..	19·37	..	..	..	19·3
"Penelope"	..	..	..	..	..	28·8	..	28·8
"Monarch"	..	29·25	..	..	24	..	21	26·57
"Temeraire"	..	..	34	21	..	..	..	27·5
"Invincible"	..	..	..	..	12·6	..	..	12·6
"Inflexible"	22	..	..	..	..	..	..	22
General average..	22	29·25	30·06	19·79	14	28·8	21	20·6

The General Character and Defects of the Egyptian Defences, &c.

The forts and batteries of the coast-line of Alexandria may be divided into three classes, viz.:—

I. *Modern works.*—These include—
Sea Battery of Pharos.
A Battery of Adda.
Centre Battery—Ras-el-tin Lines.
II. *Obsolete works.*—Including—
Remainder of Pharos.
Remainder of Adda.
West Battery—Ras-el-tin Lines.
Ras-el-tin Fort.
Oom-el-Kubeba.
Meks Sea Lines.
III. *Unfinished works.*—Such as—
Hospital Battery—Ras-el-tin Lines.
Meks Fort.

I. *Modern Works.*—These were both in trace and in profile of considerable strength, and have consequently sustained little damage. The value of the Pharos Battery was, however, much diminished by the distance from it at which stood the magazine; while A Battery in Adda owed its defeat to the faulty construction and position of the same adjunct. The Centre battery of Ras-el-tin Lines must, in any case, have soon ceased firing on account of the defective pivots of the guns.

II. *Obsolete Works.*—None of these defences were provided with traverses, if we except the left bastion of Ras-el-tin Fort, which was, in consequence, very cramped. The stores and barracks were in all the forts exposed and weak: there was in fact no bomb-proof cover along the whole line. The parapets of most of the batteries of this class were very weak, and in many cases too low also. No effort was in any case made to defilade any portion of the work with traverses or parados, and the magazines were rarely in security, while many portions of the line could be enfiladed from points on which no gun could bear.

III. *Unfinished Works.*—As such these are beyond criticism, but it appears probable that had time permitted the completion of these batteries, they would have equalled, if they did not surpass, in strength those of Class I.

One great error in the character of these defences is worthy of notice, namely, that of all the forts, no two could support each other, while each was individually weak in armament, if not in defensive power.

Thus Pharos with six rifled guns could not bring one of them to bear on a ship which lay west of Adda, and the latter, on the other hand, from which Pharos bears north-east, had the muzzles of three of its four large rifled guns pointed due west. How could either of these forts con' nd singly with such odds as three ironclad ships armed with twenty-eight rifled guns?

The same may be observed along the whole line, with the possible exception of Fort Ras-el-tin, the West and the Centre battery of Ras-el-tin; and as the result of this exception we find that the two ships which attacked this portion, the "Alexandra" and the "Sultan,"

received between them a number of hits exceeding the total of the whole of the remainder of the squadron.

The main faults of the Egyptian defence may be summed up as follows :—

1. The forts and batteries were unable to support each other.
2. There were too few traverses, and no parados.
3. There was no bombproof cover.
4. The parapets were often weak, and not of sufficient height.
5. The revetments of the cheeks of the embrasures and of the interior slopes, being of stone, frequently blocked the trucks of the platforms, and must have caused numerous casualties.
6. The stores were all exposed to fire, and the magazines were small and inconveniently placed even when they were in some degree safe.
7. The pivots of the guns were faulty in design, and bad in construction.
8. There was by far too small a stock of ammunition in readiness, and sufficient means were not available to ensure the supply of more during the action.
9. Many of the S.B. guns should not have been fought, but the detachments available for them should have been utilized as reliefs for the M.L.R. guns.

It is naturally difficult to arrive at any certainty with regard to the loss of the Egyptians in killed and wounded. They, themselves, place it at 280, while the Officers of the Navy estimate it at about 500. From what I have seen I should feel inclined to believe that the former number might represent the total of those who fell in the batteries, while the latter might include the losses of the infantry who are said to have been drawn up in rear of the forts. The number of men working at the guns did not probably exceed 2,000; it is said, on good authority, that these gunners were for the most part Nubians, and were the best troops in the Egyptian Army.

Effect of the Fire of the Fleet on the Ordnance of the Forts.

The total number of pieces which were dismounted on the 11th of July was—

Four M.L.R. guns;
Sixteen S.B. guns;
One mortar;

and it is proposed to examine into the conditions under which these casualties arose.

M.L.R. Guns Dismounted.—Rifled guns. These were—

(i.) An 8-inch gun in West Battery, Ras-el-tin Lines.
(ii.) A 9-inch gun in Right Bastion, Ras-el-tin Fort.
(iii.) An 8-inch gun, south-east face, Ras-el-tin Fort.
(iv.) An 8-inch gun, Meks Fort.

(i.) The 8-inch gun in the West Battery was struck on the breast of the carriage by a shell which entered the battery through the embrasure.

This is a casualty which must always remain possible so long as embrasures are used, and are not provided with iron shields; but it is

open to doubt whether in the case of the Egyptian forts there was not, as a rule, too large a space (sometimes as much as 2 feet) between the sill of the embrasure and the muzzle of the gun.[1]

(ii.) The 9-inch gun in the right bastion of Ras-el-tin-Fort.

The parapet in front of this gun is 8 feet high, of which height 7 feet only are revetted, a fact which as regards the effect of shell practically reduces the available cover to the smaller dimension. The shell has cut away the crest for a depth of about 2 feet, and has struck the gun on the trunnion coil rather below the axis of the piece. The burst has flung the gun from its position, and broken up the carriage.

This casualty is, I think, due almost entirely to the little cover which was given by the parapet; had the latter been 2 feet higher the gun would probably have escaped, though the detachment would certainly have suffered from the splinters of the revetment.

(iii.) The 8-inch gun, south-east face of Ras-el-tin Fort.

Since the destruction of this gun was an accident, it having been dismounted by shell which were intended for the 10-inch gun, there is little to notice beyond the absolute necessity for the construction for a parados in all cases where guns may under any circumstances be exposed to reverse fire. The casualty is, however, an excellent proof of the accuracy of the fire of the fleet, since three if not four shells have fallen within a space 10 feet square.

(iv.) An 8-inch gun, Meks Fort. This gun has been dismounted in a similar manner to (i), with this difference, that the parapet being even lower (only about 5 feet) the shell has not touched the crest. The embrasure was indeed so shallow that the gun was practically mounted *en barbette*.

It is worthy of note that in only two of these four cases (viz., ii and iv) was the gun itself injured, while the carriage was injured in three cases (i, ii, and iv), and the slide, more or less, in all.

I would further draw your attention to the fact that casualties (i,) (ii,) and (iv) occurred in batteries which were not provided with traverses of any kind, while (iii) was, as has been before mentioned, practically accidental.

S.B. Guns Dismounted.—Smooth-bore guns. These were as follows:—

(*a.*) Four 6·5-inch guns in the casemates, Fort Pharos.

These casualties were the natural consequence of the accurate fire of heavy shell on casemates of inconsiderable thickness, and constructed of bad material.

(*b.*) Two 6·5-inch guns on the rear face, Fort Pharos.

The dismounting of these guns was an accidental consequence of the fire directed on the west face.

(*c.*) One 10-inch gun on the west tower, Fort Pharos.

There is some reason to believe that this gun overturned on recoil, but personally I am inclined to think that it was dismounted by a 16-inch shell.

(*d.*) Two 10-inch guns in C Battery, Fort Adda.

[1] Shells have in various cases in the course of the bombardment struck the muzzle of a gun without causing any injury.

The right gun in this battery was certainly dismounted by a shell, but there is some doubt as to the left gun.

(*e.*) One 10-inch gun in B Battery, Fort Adda.

This gun was probably dismounted by fire.

(*f.*) One 10-inch gun in D Battery, Ras-el-tin Lines.

Probably dismounted by a shell.

(*g.*) One 6·5-inch gun in Saleh Aga.

This gun was certainly dismounted by fire; it is still loaded.

(*h.*) A 10-inch gun in the battery between Saleh Aga and Oom-el-Kubeba.

This gun was hit on the trunnion by a shell.

(*i.*) A 6·5-inch gun in the same battery.

This gun, which, strictly speaking, was not dismounted, since the breech and trunnions remained on the carriage, in all probability, burst since the chase for a length of 4 feet from the muzzle is lying *in front* of the battery.

(*j.*) A 6·5-inch gun in Oom-el-Kubeba.

It appears probable that this gun burst, since the only parts of it which remain are—the breech which lies about 30 yards in rear of the parapet, and a fragment weighing about 4 cwt., which is imbedded in a wall about 70 yards to the left rear of the original position of the gun.

(*k.*) A 10-inch gun, A Battery, Meks Sea Lines.

Perhaps dismounted by fire, but these batteries were disarmed about July 13th, by landing parties sent ashore for that purpose.

Of the above guns all except (*a*) and (*e*) were mounted *en barbette.*

It is exceedingly difficult to decide, in the absence of any visible hit, whether a gun may or may not have been dismounted by fire, and there is good reason to believe that, in addition to those overthrown by blue-jackets after the bombardment, many of the guns now dismounted, overturned in consequence of the united effects of increased charges and extreme elevation used by the Egyptians in their endeavours to obtain greater range.

Guns, not Dismounted but otherwise Unserviceable.—Of these, among the M.L.R. guns, there were certainly six, and others might possibly be added.

(i.) The 10-inch gun, Fort Pharos.

Blocked by the ruins of the revetment.

(ii.) The 10-inch gun, Fort Adda.

This gun is off the racers.

(iii and iv.) The two 7-inch guns in the Hospital Battery, Ras-el-tin Lines.

These are both blocked by the ruins of the revetment, and one is in addition off the racer.

(v.) The 9-inch gun in right bastion, Ras-el-tin Fort. Holdfast broken.

(vi.) The 9-inch gun in left bastion, Ras-el-tin Fort. Keep-pin broken, and ties of the holdfast drawn.

In the cases of (i) and (ii) the holdfasts were damaged, as were also to a lesser degree those of all three guns in the centre battery, Ras-

el-tin Lines. Attention should also be directed to the almost universal damage, amounting in many cases to fracture, suffered by the sockets of the running-up levers of the M.L.R. guns.

With regard to the 13-inch mortar which is included among the dismounted ordnance, it is uncertain whether it burst or was struck by a shell. It stood in D Battery, Ras-el-tin Lines, and a large fragment, weighing perhaps 3 cwt., was carried thence to the left rear, over the Palace wall, and fell near the entrance gate, at a distance of about 250 yards from its original position.

The following table gives the amount of serviceable and unserviceable ordnance at the termination of the bombardment:—

Effects of the Bombardment on Ordnance.

Fort or Battery.	Dismounted.			Otherwise Unserviceabe.			Serviceable.			Total.		
	R.	S.B.	M.	R.	S.B.	M.	R.	S.B.	M.	R.	S.B.	M.
Fort Silsileh.....	..	..	..	..	..	..	2	3	1	2	3	1
Fort Pharos.....	..	7	..	1	4	..	7	26	4	8	37	4
Fort Adda.....	..	3	..	1	..	..	4	11	5	5	14	5
Ras-el-tin Lines....	1	1	1	2	..	..	6	29	9	9	30	10
Fort Ras-el-tin.....	2	..	..	2	..	..	2	28	3	6	28	3
Fort Saleh Aga	..	1	..	..	..	..	..	11	..	..	12	..
Battery.....	..	2	..	..	..	..	..	2	..	..	4	..
Fort Oom-el-Kubeba	..	1	..	..	..	..	2	15	2	2	16	2
Fort Kamaria.....	..	..	..	..	..	..	..	5	1	..	5	1
Meks Sea Lines....	..	1	..	..	..	..	..	23	..	..	24	..
Meks Fort	1	..	..	..	..	..	4	9	5	5	9	5
Total.....	4	16	1	6	4	..	27	162	30	37	182	31
	21			10			219			250		

Effects of the Bombardment on the Revetments of the Forts.

Any details which it may be possible to give on this subject must lose much of their value from the fact that during the bombardment no deliberate attempt was made to form practicable breaches in the revetments; rather, except in the instance of the casemates of Fort Pharos, the escarps were struck only by shells which had failed to reach their mark, the parapets above.

There was thus no careful placing of hits, and no systematic pursuit of a given object: the result, as might be expected, is that the various scarps are injured to a uniform extent in all parts, while in no case has a practicable breach been formed in one of the higher revetments.

Again, with a few exceptions, the guns used in the bombardment of Alexandria were not such as could be available for siege purposes, while the masonry of the forts was certainly of less than an average quality.

As examples of the action of the fire of the fleet on revetments, I produce the following elevations:—

(i.) The casemates on the left flank of the sea-front, Fort Pharos.

(ii.) The A Battery, Fort Adda.

(iii.) The bastioned front which forms the west face of Fort Ras-el-tin.

(i.) The following are the dimensions of the principal hits:

2. 14 feet high, 16 feet wide, probably several shells, of which one has pierced the casemate beyond the angle.

4 and 5. Probably three or four shells. The outer casing of the wall is demolished to a depth of 18 inches. The casemate is pierced and the gun wrecked.

7. A shell has penetrated and ruined both gun and carriage.

8 and 9. Probably bursts: outer casing of wall gone.

10. Two Palliser shells (10-inch) have pierced the casemate, and wrecked both gun and carriage.

11. Breach 12 feet wide and 9 feet deep, probably two or three shells.

13. Probably a burst—no injury done.

14. The wall is torn away, and the casemate pierced. The gun and carriage are utterly ruined.

15. The tower was pierced by a shell which burst inside.

(ii.) A Battery, Fort Adda.

1. Possibly a burst—no great penetration—two fragments of shell found beneath.

2, 3, and 4. Probably Palliser shells—did not burst—about 4 feet penetration.

5. Shell burst on cordon.

6 and 8. Similar to 2, 3, and 4.

7. Shell burst—penetration about 8 feet, but has not reached the back of the rubble wall. Gas-check found in the *débris*.

9. Probably four Palliser shells; all penetrated deeply, but did not burst; outer face of wall scaled off to a depth of 1 foot.

10 and 11. Single Palliser shells—blind. There were no traces of Gatling or Nordenfeldt bullets on this scarp, but the face of the wall was pitted with shrapnel, many bullets being found imbedded in the stone, while others had rebounded to the ground.

(iii.) Bastioned front, Fort Ras-el-tin.

1. Hit just above the cordon, penetrated the parapet, and burst.

2. The shell did not burst. Hole 3 feet 6 inches, 2 feet 6 inches wide, and 3 feet deep.

3. A similar hole. A 10-inch common shell (blind) lies 6 feet from the wall, with its point to the escarp. It probably rebounded, as the wooden fuze is knocked out.

4. Probably a Palliser shell—did not burst. Penetration over 8 feet.[1]

5. Burst on the cordon. 7 feet 6 inches × 4 feet.

6. Similar to 2.

7. A 10-inch common shell burst on the wall. Scaled off stone for an average depth of 1 foot over an area 7 feet 6 inches × 4 feet; splinters of the shell found.

8. Two shells, which did not burst; great penetration.

9. Perhaps two hits, which brought down the angle for a depth of 14 feet below the cordon. A third shell has penetrated without bursting.

10. A single shell burst; diameter of crater about 6 feet; penetration 3 feet.

11. A similar hole; penetration 2 feet.

12. A practicable breach; the shell has pierced the scarp and burst; width of breach 10 feet.

13. Hole 9 feet × 6 feet. Shell (blind) penetration over 8 feet.

14. Breach 18 feet wide. Two or more shells. Penetration, 6 feet.

15. Shell burst—8 feet × 5 feet—depth 15 inches.

16. Diameter of hole 5 feet; penetration 3 feet 6 inches; shell burst.

17. 3 feet 6 inches penetration; under this point, at a distance of 8 feet from the wall, lies a 10-inch common shell. The fuze has apparently blown.

18. A breach about 12 feet × 8 feet. Probably two shells; penetration great.

19. Hole 8 feet × 4 feet 6 inches. The shell has run down into the ground without bursting. Near this point is a 64-pounder (blind) shell, about 10 feet from the wall.

20. Penetration 8 feet at the top; into the parapet; a good burst; breach 12 feet × 6 feet.

21. Angle of scarp carried away to a depth of 12 feet 6 inches. Impossible to say how many shells.

22. Perhaps two shells; good burst; hole 15 feet × 11 feet. Penetration 5 feet in centre.

23. Burst on the exterior slope; 9 feet of the cordon carried away.

24. Apparently the crater of a small shell; hole 4 feet 6 inches × 4 feet, depth about 3 feet 6 inches.

Although from the above it would appear that there is some uncertainty as to the penetration of shell under apparently similar circumstances, yet we may, perhaps, form the following conclusions, and believe that they will, as a rule, hold true.

(*a.*) A large shell, on striking the wall, scaled off a portion about 5 feet in diameter.

(*b.*) If it were a Palliser shell, and blind, its penetration was generally at least over 8 feet.

[1] There were no means of measuring a greater depth than 8 feet.

(*c*.) In the case of a burst, the penetration rarely exceeded 3 feet 6 inches.

The base of the escarp was almost certainly thicker than the top, since a penetration of 5 feet at the cordon showed traces of earth, while at a depth of 8 feet, a shell which had pierced the lower part of the wall had not reached the back of the rubble masonry.

Some parts of this scarp were marked with shrapnel bullets, but there were no signs of the missiles of either Gatling or Nordenfelt guns.

Since, as was before mentioned, it was not an object with the fleet to make practicable breaches in the revetments, it will be scarcely necessary to further consider this section, and we may pass on to the more important considerations regarding the effect of projectiles on earthworks.

The Effects of the Bombardment on the Parapets of the Forts and Batteries.

Before proceeding to consider the general effect on the parapets of the fire of the fleet, it may be well to examine more particularly into the two cases of which plans are produced.

(i.) The bastioned front of Fort Ras-el-tin.

The hits shown on this are as follows:—

1. The neck of the embrasure of the 8-inch gun is ruined; the block of concrete which formed the left cheek, having been torn out, is now under the gun. This injury is the work of from two to four shell, which have passed over the 10-inch gun in the left bastion.

2. The face of the traverse is broken down, and the passage to the expense magazine blocked—one or two shells.

3. A burst at the end of a trough.[1] Length 18 feet, width 7 feet, depth 2 feet 6 inches.

4. The neck of the embrasure damaged by two shells, which both burst.

5. The trough of a blind shell. Length 7 feet, width 5 feet, depth 9 inches.

6 and 7. Probably the craters of small shell.

8. The scarp is broken down at the angle, to 14 feet below the cordon.[2]

9. Trough of a blind shell. Length 12 feet, width 4 feet, depth 2 feet 3 inches.

10. A similar trough, same dimensions.

11. A similar trough, depth 1 foot 6 inches.

12. A practicable breach, wall cut down 5 feet below the cordon.[3]

13. Trough and burst, width 12 feet; the interior slope is cut down nearly to the terreplein.

14. A large breach in the scarp,[4] 13 feet by 15 feet, in consequence of which the parapet has fallen.

15. Trough of a blind shell, length 12 feet, width 4 feet, depth 1 foot.

[1] I on elevation. [2] IX on elevation. [3] XII on elevation.
[4] XIV on elevation.

16. Crater of a burst shell, 12 feet by 9 feet, depth 3 feet 3 inches.
17. The angle of the scarp is cut down to 6 feet 6 inches from the foot.[1]
18. Splinters and small shell.
19. Neck of the embrasure destroyed; this was possibly the shell which dismounted the 9-inch gun.
20. Hit at the cordon.[2]
21. Trough and burst, length 10 feet, width 8 feet; the interior slope is cut down 4 feet from the crest.
22. A burst, length 10 feet, breadth 14 feet, scarp cut down 9 feet from the cordon.
23. Trough of a blind shell, length 13 feet, width 6 feet, depth 1 foot 6 inches.

If we analyze these hits, we shall find that they may be divided under four heads, as follows:—

(i.) Hits on the scarp which have penetrated to the parapet; such are, for example, 3, 8, 12, 14, 17, 20, and 22.

(ii.) Hits on the exterior slope, such as 6, 7, 9, 10, 11, 16, and 23.

(iii.) Hits on the superior slope, such as 13 and 21, and perhaps 5 and 15.

(iv.) Hits on the embrasures, as 4 and 19.

The 1st class we may dismiss without comment, since they are in no case likely to cause damage.

The hits on the exterior slope, which were in all the forts the most frequent, form almost invariably troughs, though in rare cases (as 16) the shells may burst.

Hits such as 13 and 21 are the most to be dreaded: such hits were rare, but only so because the superior slope was seldom struck.

The 4th class, hits on the embrasures, were not common, and unless when the shell struck near the neck not disastrous, except on account of the splinters which flew from the revetment.

(ii.) The sea-front of Oom-el-Kubeba.

The hits on this fort were exceptional in their character, being, as they were, for the most part the work of 16-inch shells. They were as follows:—

1. Counterscarp cut down 9 feet, an easy descent into the ditch, width 10 feet.
2. Counterscarp cut down 5 feet, width 7 feet.
3. Counterscarp cut down 6 feet, width 10 feet.
4. Scarp cut down 6 feet 6 inches, width 7 feet 6 inches; breach nearly practicable; the parapet has fallen in behind the scarp, probably at the point of the burst of the shell.
5. Scarp cut down 6 feet 6 inches, width 20 feet; accessible.
6. A small breach, scarp cut down 4 feet, width 4 feet.
7. Parapet cut down 3 feet below crest. Trough 16 feet long and 8 feet wide. This is the only case along the whole line of defences in which a shell, having struck on the exterior slope, has pierced the parapet and breached the interior slope; thickness of parapet 12 feet.
8. A crater of a burst shell, diameter 7 feet, depth 3 feet.

[1] XXI on elevation. [2] XXXIII on elevation.

9. Shell has struck the superior slope; trough 8 feet long, 17 feet wide; parapet cut down to 1 foot above terreplein, probably a burst. It is possible that this shell knocked to pieces a 6·5-inch S.B. gun which stood at this point.

10. Crater of a small shell, diameter 2 feet 6 inches, depth 9 inches.

11. Shell has struck the superior slope; length of trough 13 feet, width 14 feet; parapet cut down to 1 foot 9 inches above terreplein; possibly a burst.

12. Trough and crater of 16-inch common shell; length of trough 25 feet; diameter of crater 15 feet, depth 4 feet 6 inches.

13. Trough and crater of 16-inch common shell; length of trough 26 feet; diameter of crater 16 feet, depth 5 feet. In this crater lay a splinter of the shell.

The character of the last two hits is similar in every way; the only difference between them is caused by the fact that 13 struck the exterior slope a little lower than 12, and has, therefore, cut away more of the parapet.

The interior slope was quite uninjured by their action, and the guns were absolutely untouched.

If we analyze the hits on this fort we find 1, 2, 3, 4, 5, and 6 were hits on the scarp and counterscarp, and may be passed over as without effect.

7, 8, 12, and 13 were hits on the exterior slope, of which 7 only pierced the parapet.

9 and 11 were hits on the superior slope, and being such were dangerous.

If we consider the great size and weight of the majority of the projectiles used against the forts of Alexandria, and further realize the velocity at which these masses of metal were travelling at the moment of impact, together with the capacity of the common shell and the consequent amount of their bursting charges,[1] we cannot, I think, fail to be astonished at the small effect that such powerful missiles have produced on the sand parapets, especially when we remember that the latter were, in many cases, according to modern theory, far too weak to afford any real protection. It is a fact, and one on which too much stress cannot be laid, that in only one instance was any one of the parapets pierced by a shell from the fleet.[2]

In some few cases, where a shell had fallen on the superior slope, it has breached the interior slope, and has torn away the revetment for an average width of 15 feet, and has thus done very considerable injury to the defenders by the shower of stones and splinters which it has thrown into the interior of the fort. But there is among all the forts and lines but a single example of a shell which, having struck the exterior slope, has succeeded in penetrating the parapet, or even by its burst, in shaking the revetment of the interior slope.

[1] The bursting charge of the 16-inch common shell is 60 lbs. of powder, and the shell when full weighs 1,700 lbs.

[2] No. 7 on sea-front of Oom-el-Kubeba. See *ante*.

The shells have, as a rule, cut troughs of greater or less depth in the parapets; at the end of these troughs one or other of three effects have been produced.

(i.) In cases where the shell has burst, a distinct crater is formed, which varies in depth and diameter in proportion to the size of the shell and its position at the time of bursting. Of this form of effect good examples are not common.

(ii.) When the shell has been blind, it has been found that the trough has gradually grown shallower, and at last abruptly ceased; from this fact I should wish to draw the conclusion that in such cases the shell has bored its way upwards through the parapet, and having escaped has passed on over the battery. Examples of this action are very common.

(iii.) Again, in other instances, the blind shell is found lying on the parapet at the end of its trough. In explanation of this fact, I should desire to suggest that, in all probability, in such cases the shell has not, after having pierced the parapet, sufficient velocity remaining to carry it on; it has thus first reared up on its base, and has finally fallen on the parapet. Such shells invariably lie with their heads towards the points from which they came.

The dimensions and character of some of the principal examples of the above action are given below.

Shell Troughs.

Fort Adda.—A well-marked trough, 16 feet in length, no crater, shell gone on.

Centre Battery, Ras-el-tin Lines.—Trough of a 10-inch Palliser shell, 12 feet long, 3 feet deep. Shell present, point reversed.

Magazine. Centre Battery.—Trough 15 feet long, 3 feet deep, no crater, shell gone on.

Fort Ras-el-tin.—Nos. 5, 9, 10, 11, 15, and 23.

Oom-el-Kubeba.—Nos. 12 and 13, and a similar hit at south-west corner of which the crater is 15 feet in diameter, and 4 feet 6 inches deep.

I beg to offer for discussion the following suggestions as to the cause of the above-mentioned action of shells which have struck the exterior slope of a parapet.

In the first place we may assume that one law governs all three cases, since in (i), had the shell not burst, it would probably have acted as in (ii) or (iii), while these last differ from each other only with respect to the velocity of the two projectiles.

Secondly, it will be allowed that at the moment of impact on the exterior slope, the shell is falling, and that its course, therefore, makes an angle with the horizontal plane. This angle is in the plate assumed to be 6°.

Thirdly, the shell, owing to the elevation of the gun from which it was discharged, is itself inclined at an angle to the horizon in such a manner that its point is higher than its base. This angle is in the plate assumed to be 3°. We have thus a projectile of which the axis is inclined at 3°, and which is falling at an angle of 6°.

It is obvious that a shell so moving cannot strike the exterior slope with its point; rather, so to speak, it crashes through it, and does not pierce it.

Having entered the parapet, the shell, which is now moving in a medium offering far more resistance than did the air, has a constantly increasing tendency to change its original direction for a course in prolongation of its axis, since thus it will encounter the least possible resistance.

Again, since in the cases observed the shell had cut a trough and not a tunnel in the parapet, the pressure will be greater on the lower than on the upper side of the head; for the earth below stands firm while the earth above gives way.

The shell, therefore, advances on a curve, the shape of which depends upon the combined effect of its velocity, its weight, the shape of its head, and the character of the resisting medium in which it is moving, but in all cases tending to bring the projectile to the surface of the parapet. On escaping from the sand, the shell, if it has sufficient velocity remaining, flies on, but if that velocity be exhausted, falls at the end of its trough.

The lower the velocity of the projectile at the moment of impact, the sooner will the tendency to rise act upon it,[1] while the larger the amount of parapet which a projectile has to pierce, the longer will be the time during which this tendency will act; in many cases, therefore, when the shell, from either of these causes, can but just reach the surface, it probably issues almost vertically from the sand. It would thus, on coming into the air, overbalance into the trough which it has itself cut, and would so lie with its head pointing towards the point from which it came.

If this explanation of the behaviour of shells be accurate, we should expect to find that, in fact, they do rise in their course, and such is, indeed, the case, as may be seen by the following examples:—

(i.) No. 7 hit, Fort Oom-el-Kubeba. The shot has risen about 3 feet 6 inches during its passage through the parapet, in a distance of 17 feet.

(ii.) The bottom of the crater of No. 12 hit in the same fort is about 6 inches above the point of impact of the shell, which passed through about 16 feet 6 inches of the parapet before bursting.

(iii.) No. 11 in Fort Ras-el-tin rose about 2 feet 6 inches in its course of 12 feet.

(iv.) No. 23, in the same fort, rose about 3 feet while passing through 13 feet of parapet.

Be the cause of this action what it may, the fact remains that under present conditions even heavy guns will fail, at a mean range of 2,500 yards, to penetrate a 24-foot parapet; and this is the case, not because modern shells are wanting in weight or velocity, but because while traversing a parapet they are forced into a false direction.

What remedy may be available to cure this defect of modern guns,

[1] It has, however, been proved in practice that a shell moving with a high velocity has a greater tendency to rise in a parapet than has a projectile of which the velocity is low.

I am unable to say, but I venture to draw the conclusion from what has been observed, that the conditions of successful fire against armour-plates and against sand parapets are very different in their nature.

Should, however, the shell fall on the superior slope, it will almost certainly pierce what remains of the parapet, and will tear away some yards of the interior slope.

As a protection against this danger I beg to offer for discussion a proposition to heighten the exterior slope, and to make the superior slope countersloping.

The time at our disposal will not permit me to enter into a full consideration of this question, but I base my suggestion on the broad ground, that it is wise to increase the extent of the exterior slope, on which a shell may strike with comparative impunity to the defenders, at the expense of the superior slope, on which almost every blow is deadly, and I would also urge that by the proposed form of parapet a greater thickness of earth is opposed to the action of high-angle fire, while the vulnerable superior slope is altogether concealed from the view of the enemy.

Some Points which require Attention in the Construction and Armament of Coast Batteries.

The following points, deduced from the foregoing statements with regard to the effects of the bombardment of the forts of Alexandria, are offered for your consideration as being of importance with reference to the choice of site, the details of fortification, and the provision of armament for coast batteries.

1. *It is of importance that batteries for coast defence should have a considerable command above the sea; but should not be conspicuous objects on the coast.*

No one probably will dispute this statement, for it is easy to realize that a fort standing 80 feet above the sea has greater powers of offence and defence against a fleet than has one which has an elevation of 40 feet, while the latter again is less vulnerable and more powerful than a battery *à fleur d'eau*. The real difficulty of the case lies in giving considerable elevation to a battery without making it conspicuous. But in practice what is required is not that the whole fort shall be invisible, but that the positions of the guns shall not be marked in such a manner as to render them visible at long ranges.

The Egyptian parapets and escarps were of the same colour, being covered with the same grey cement, and we have all heard of the difficulty which was experienced in seeing the guns.

On the other hand the casemates at Pharos, where the black embrasures showed distinctly against the white stone, suffered very much from fire.

From this it follows that whatever may be the material of the, so to speak, pedestal of a coast battery, the actual parapet which covers the guns should not be easily distinguishable from whatever background may be behind it.

Without mentioning names it may be said that many of our

batteries are very deficient in invisibility, and it may even be open to question whether casemates or stone forts are not, if only on this account, less desirable as defences than earth or sand batteries.

2. *The forts or batteries should not be small in size; or if small several must be built to support each other.*

If we take the average number of guns per ship in the fleet which bombarded Alexandria, we shall find that it is ten.

A fort which is armed with ten armour-piercing guns is certainly not a small fort, while it is almost certain that each fort in a system of coast defence must be prepared for action against more than one ship.

No hard and fast rule on the subject can be laid down, but the principle which I have suggested appears to be a true one.

3. *It is of less importance that coast defences be good forts than that they be good batteries.*

By this I mean that all care and money must be devoted to the sea-face, and that it is not of great importance whether the gorge be closed or not, since during a bombardment any parapet or wall used for that purpose will almost certainly be destroyed, while an attempt at a landing by the enemy is unlikely until after the guns had been silenced, and the value of the fort is gone.

4. *Great care must be taken to render the magazines and stores absolutely secure, and also to provide bombproof cover for the garrison.*

The first part of this statement needs no comment, but I would add to it a rider, that the use of several small stores and magazines is both more safe and more convenient for the service of the guns, than is that of one or two large buildings.

Bombproof cover is absolutely necessary for the protection of the wounded, &c., as well as for the shelter of the reliefs of the gun detachments, for infantry, &c.

5. *Some description of counter-guard should be made in front of all low-lying batteries, both for the purpose of deceiving the enemy as to the position of the true parapet, and of covering the latter from some proportion of the fire.*

In speaking of such a counter-guard, I have in my mind the effect produced, as I believe, by the wall in front of the left flank battery in Meks Fort.

Since it will probably never be necessary to fire the guns of the main battery with depression, the level of the top of the counterguard may be at least the same as that of the sill of the embrasure. Its distance from the main parapet should be such that no splinters would be likely to fly over the intervening space, while its solidity should be sufficient to hold or to burst every shell which strikes it.

6. *The parapet of a coast battery should be certainly* 10 *feet high, of which* 9 *feet should be revetted.*

It is absolutely necessary that the rear of the gun portion should be enfiladed at least from the bullets of shrapnel and machine-guns.

Less than 10 feet of parapet will not afford such cover, for given that the bullets fall at an angle of 10°, about $\frac{1}{6}$, such a parapet yields only 6 feet 8 inches of cover, at a distance of 20 feet from the crest.

The number who lays the gun must under the present system be always exposed to fire, though he can find some cover behind the breech.

No mention has been made of defilade from the fire of heavy shell, since it would appear from the results at Alexandria, that such a missile, if it strikes the superior slope within 6 or 8 feet of the crest, must shear away any parapet or revetment.

Fortunately it would seem that such hits are as rare as they are as destructive in their effect.

7. *Each gun should be divided from its neighbour by a bombproof traverse, and a parados should be provided in rear of each battery, in order that the remainder of the fort may be sheltered from fire.*

8. *Embrasures should be so constructed as to afford the worst possible mark for fire or sight.*

Since, if suggestion No. 7 be carried out, but few guns can be mounted in proportion to the length of a parapet, it is absolutely necessary that considerable splay be given to the embrasures, in order that as many guns as possible may be able to bear on the same point; again, if the parapets are high, the embrasures must be deep; for these two reasons they must be more or less conspicuous and vulnerable.

The weakening of the parapet, which is caused by the existence of embrasures, is a disadvantage attending their use which cannot be remedied, and woe to him who attempts to do so by revetting the cheeks with masonry. But embrasures can be, to a certain extent, disguised, if care be taken that they are marked by no conspicuous masonry, or by any distinct features of a colour strongly contrasted with that of the parapet.

Again, since it is unlikely that, except under peculiar circumstances of site, it will ever be necessary to fire heavy guns with depression, is there any reason why the soles of the embrasures should not be made horizontal, or even in some cases countersloping? In this manner both the apparent and the real depth of the embrasure may be diminished.

9. *Some provision must be made for resistance to an attack by boats.* Against such an assault, which would probably take place by night, precautions may be taken by placing Gatling, Nordenfelt, or S.B. guns, in positions whence they would be available for close defence, though not exposed to the fire of the fleet. It is unlikely that during the bombardment the ships would fire on these, since, not being in action, no indication would be given of their presence; while, except through the reports of spies, their very existence need not be suspected.

Again, the machine-guns might be placed under cover during the day, and be brought into position at nightfall, at which time, also, the artillery of the defence should hand over the care of the fort or battery to the infantry of the garrison.

10. *Mantlets of some description should be used to provide against the effects of shrapnel shells.*

11. *No revetments which can by any possibility be exposed to fire should be constructed of stone or brick.*

The Egyptians state that their principal losses were caused by splinters from the revetments, and the appearance of their batteries fully bears out the statement. No revetment is strong enough to keep out heavy shell, it serves only, if massive, to increase their effect. From this it follows that revetments for coast batteries should be used only in positions where it is absolutely necessary that the earth should stand at a greater angle than its natural slope, and that they should be constructed of some material which will neither splinter nor wound.

For similar reasons no casemates should be used which either are, or by racking could be made, pervious to even the heaviest shell.

12. *The guns should be pivoted well forward; and their muzzles should but just clear the sole of the embrasure when the gun is horizontal.*

The first of these suggestions has for its object to diminish the width of the embrasures; the second to make their depth a minimum; and both, especially with breech-loading guns, tend to close the neck of the embrasure against the enemy's shell.

Many of the guns at Alexandria were hit on the muzzle, but not one was injured by the blow, while the shell which dismounted the 8-inch gun in the west battery, Ras-el-tin Lines, passed between the muzzle of the gun and the sole of the embrasure.

It is true that if the muzzle of the gun be close to the sole of the embrasure, it will at each discharge tear away much of the latter: but such damage will not be excessive nor in a vital spot, and can in any case be repaired at night, while every inch which can be taken from the size of the embrasure is a great gain to the defence.

13. *Great care is necessary in all cases where the guns have fixed pivots, to ensure that the latter are strong enough to bear the constant recoil.*

Very many of the Egyptian guns were either unserviceable or about to become so, either from fracture of some portion of the holdfast, or from the jamming of the trucks by the masonry which surrounded the pivot.

14. *A system of reliefs must be arranged for the gun detachments.*

This is necessary, not only in order to make provision for casualties, but because the labour of serving heavy M.L.R. guns is so great, that after some time the detachment would probably decrease very much in efficiency.

It is suggested that three reliefs be provided, of which 1 and 2 should come on duty alternately for an hour, while 3 should serve to fill up casualties in either of the others.

15. *Some system, better than the present, should be provided for traversing the guns.*

The process of traversing by means of tackles, or by a cog-wheel and winch, is slow and ill-suited to practice at moving objects.

Might it not be possible to give the required motion by means of hydraulic or other power, the requisite machinery to be under the control of the number who lays the gun?

16. *Some provision should be made for the possible use of vertical*

fire against ships. For this purpose it would be well that at least ten S.S. 13-inch mortars should form a battery, and that these batteries should be placed near, but by no means in rear of the gun batteries.

The range of any ship which has anchored or taken up a stationary position having been obtained from the gun battery, a salvo should be fired from the mortars, and repeated until the ship is forced to get under way.

The Egyptians do not appear to have used their mortars during the defence of Alexandria, for the reason, probably, that on account of their position which was almost invariably in rear of the guns, it was impossible to keep up a simultaneous fire from both weapons.

In concluding this paper, I beg to renew my former acknowledgments to those Officers who have assisted me in its compilation.

Finally, I venture to hope that among the many Officers whose experience or knowledge renders them far more capable than myself of judging of the value of the details which I have brought before you, those who may find in my paper nothing true that is new, or nothing new that is true, will be merciful to my shortcomings out of consideration for my good endeavour.

The CHAIRMAN: I am sure we all feel very much indebted to the lecturer for the interesting account he has given us of the observations he made whilst inspecting the works at Alexandria. He has brought the subject before us in a paper of a highly scientific character, and it is one on which I feel considerable delicacy in offering any remarks. At the same time, I understand, it is wished that there should be some discussion on the subject, and therefore we shall be glad to hear any remarks that any Officer has to offer. I confess I feel very great reticence in making any myself; because, first of all, the greater part of the paper is a naval subject, and the rest is entirely a matter of artillery and engineers, but no doubt there are Officers of these three services present, who know a great deal more than I can possibly do on those subjects.

Admiral Sir ASTLEY COOPER KEY, G.C.B.: I came here this afternoon quite unprepared to enter into any discussion upon this paper, and only rise as no other person appears inclined to take part in the discussion. I shall, therefore, only refer to one or two points that have occurred to me while listening to the interesting lecture, without attempting to discuss it in detail. And first, will you allow me to say, that I take exception to the use of the term "bombardment of Alexandria"? For my own part, I had no idea that the number of shell that fell in the town of Alexandria by accident was so small as I heard was stated, in the first part of this lecture, given a few days ago. It seems that the number of shell that actually fell in the town were very few indeed, and that they certainly did not cause the conflagration, but although instructed people know well that there was no bombardment of Alexandria, the world in general have spoken of it as if it was an attack on the town itself, and that it caused the destruction of a great part of it. Anyone who has followed the mode of attack will see that the Admiral was very much hampered in his attack on the forts, by his endeavour to avoid damage to the town, and I think we must say that he was thoroughly successful in that endeavour. I, therefore, deprecate the use of the words "bombardment of Alexandria." We should rather call the operations of the 11th July the attack on the forts of Alexandria, or "the destruction of the forts of Alexandria," but I should not use the word "bombardment." I was not fortunate enough to be able to be present on Friday to hear the first part of this very useful and able paper, but from what I have heard to-day, I must say that I generally concur with the lecturer in the views that he has given as to the mode of construction of coast batteries, except in one or two points, and it is simply to bring forward those one or two points that I have ventured to say a few words. In the

first place, I do not think it would be wise not to close the rear of a coast battery, because if you do not do that you leave a very weak point open for attack by a small landing force. There is a temptation, in such a case, for an enemy to land in the vicinity of the battery, and there you are with all your guns in front and open in the rear. In such a case the capture or destruction of the fort is easily ensured, unless, indeed, there were a large army in the vicinity. I am also not sure that a *parados* in the rear of guns is advisable; for in many cases, unless skilfully placed, it would form a shell trap, and a good deal of the effect of the shell may take effect on the gun's crews. I entirely concur in the use of earthworks as against ships in preference to masonry or brickwork. I think this is one of the most important points that we can insist upon. There are positions, like Spithead and others, where you cannot have earthworks; but wherever you can, place earthworks against ships, and I have for many years come to the conclusion, after considerable personal experience, that earthworks are far more secure for defence than stoneworks. I also concur in the view of placing the work high above the water level, up to about 100 feet. I do not think it is wise to place it above that, but from 60 to 80 feet is the best height for batteries to be placed. I would also place the batteries inland, at various distances if possible, and that the ships could never approach them within 2,000 or 2,500 yards; that places them beyond the effective fire of machine-guns, which, notwithstanding the little effect which they produced at Alexandria, I am confident we shall find a most valuable auxiliary in our ships wherever we can bring them within effective range of the works. At Alexandria they were at too great distance away to be of important effect, both as regards the Gatlings and the Nordenfelts. I hope that no one will think that I am an advocate for timidly attacking forts by ships. The two instances that we have had of late years, at St. Jean d'Acre and Alexandria, show that the Admirals commanding the fleets in each case just knew what they had to do, that they could do it, and they did it; but, depend upon it, the men who commanded the fleets, both at Acre and Alexandria, would not have taken the fleets they then commanded in the same way against fortresses of the highest class, with thoroughly well-trained gunners to work the guns. They formed a right estimate of what they had to meet, both in men and material, and from all that I have heard to-day, I feel more proud of the work of our fleet during the few hours during which it was employed, in driving the men from their guns, than I was before. You must not compare it to a siege where you can sit down and make a breach; the ships were moving; they were at such a distance that they could hardly see the guns or embrasures. Any attempt to make a *breach* from ships is out of the question. There was, evidently, no little real damage done to the works by the heavy fire brought upon them. This will induce us to be cautious in attacking permanent first-class fortresses with ships, but in this case we obtained possession of all the works in a few hours, with little or no real damage to our ships; and I should be glad to know what drove the enemy from their guns. There is one point with regard to the construction of forts, that I think might be added; that is the great advantage such works would have if they had a number of smaller guns in addition to their heavy ordnance. A large proportion of the exposed hull of the ship is unarmoured and penetrable by 64-pounders, and I believe that any works against which ships could be brought would have very much increased power if they had a considerable number of small shell guns in addition to those for penetrating armour. We are adopting this system in our ironclads, and I think the same rule holds good with regard to fortifications.

Colonel Lord WAVENEY, F.R.S., A.D.C., &c.: I must be permitted, in the first instance, to remark on the opening sentences of the gallant Officer who preceded me with respect to the term "bombardment of Alexandria." I quite understand the objection, but I trust it will not be held to have lost its place in the public language of Europe, inasmuch as in the debate on the Address, Lord Granville took particular care to point out the accuracy with which the Officers of Her Majesty's navy directed the fire of their guns exclusively against the forts with which they had to contend. That is a great thing to be said of the military service, under such circumstances, and it will always be considered, no doubt, as a very great credit to the combatant Officers of the expedition. Then, with regard to the lecture to which I have listened with a very great deal of pleasure, it has two very great advantages,

it seems to me. It leads us to think something of the future, and it reminds us of something of the past, which it is well not to forget. With regard to the future, I was particularly struck, in the early sentences of the paper, with the statement that the attacking force should resemble, as nearly as possible, floating batteries. No doubt our present enormous vessels contain great power of destruction, and as it seems to me also they contain great power of construction. This was brought very prominently forward some years ago, when I had the good fortune to be at Spezia, when experiments were made with the 100-ton guns. They were the guns intended for the "Duilio," and they were towed across the bay to the constructive base for breaching. There was first a large raft, of which I do not remember the dimensions—they are given in the papers of the Artillery Institution—on which the 100-ton gun was placed, for the purpose of experiment; and below, there was a deck of some 6 or 4 feet, which contained all that was necessary for working the gun, in addition to the steam power. Now, I am one of those who think that our mechanical appliances and our great wealth are capable of completing any experiment under any circumstances, anywhere. I believe I do not attach too much importance in that respect to the power of the Royal Navy. Referring also to our heavy ironclads, and the depth of water which they must require for their operations, and, seeing that there are many maritime fortresses as to which it would be very difficult to get an ironclad within breaching distance, I think it might be well if we had practically (as suggested by the lecturer), raft batteries. It seems to me, taking one of our large expeditions, such as that which appeared before Alexandria, with its power of carrying guns, and of turning out, even at sea, carpenter's gangs for the purposes of raft work, it might be very possible to form raft batteries, each capable of bearing such a 100-ton gun, as I saw at Spezia, which might be taken into shallow water and be made useful. It might be towed in by steam power. Then there is another thing; great weight has been laid on the invisibility, so to speak, of the engines of attack. This struck me particularly at Spezia. The first occasion on which I saw this large raft lying in position was on a blowing January day, when the sky was grey and the water grey. Any Officer will know how difficult it is to mark the position of any construction that is not at a very considerable height above the sea, and at that time this raft was almost invisible from any distance. I cannot, therefore, but think that great use might be made of our constructive power on occasions, or in emergency, by sending forward a raft battery so to speak, in advance of the heavy ships. Then there was another point with regard to this invisibility; the gallant Officer who has given us this lecture, spoke of the advantage of counter-guards. It appeared to me, in the old system of fortification, there must be some other reason for the counter-guard that we see in the Vauban system, than that of mere defence. In order to recall that specially to the recollection of gentlemen who have given their attention to it in the present day, I would remind them that the weak point at Strasburg, at the last siege, was protected from the German fire by a system of counter-guards, which lay in front of the point to which the German army desired to direct their force, and the result was, that that army was delayed in its progress for a considerable time. With regard to coast batteries, which come more immediately under the experience that I have had, I quite agree with what has fallen from the gallant Officer, as to the propriety of having them closed in the rear. They should be closed in rear no doubt, or they might be surprised at any time. But there is another simple plan which the French artillery practised continually, and it was this: they always marched into batteries with their carbines, and it is perfectly possible to organize such a defence with carbines, that you may carry on a gun defence against boats, and also a carbine defence against an attacking force. Then, again, with regard to the suitable height at which batteries should be placed, I recollect the instructions given us in 1853 with regard to coast batteries were, that the angle of depression should be 3°, and that will give a range suitable at all events for the artillery of those days, and a safe and easy means of determining the face of the battery. Another particular instruction then given us was, that what may be called the run of the sea in front of each battery should be accurately tested, so that you might be perfectly certain that the tendency of the state of the sea would be to bring the boats within the direct line of your artillery fire. I believe that was laid down as

a general rule for us, and it was so acted upon, but, as regards the power of invisibility, I believe that will be developed very much and very safely. With regard to the contrasted effect of heavy masses of fire and single fire, a very great deal has to be said as to the nature of the soil, and the mode of attack.

Lieutenant SLEEMAN, late R.N.: In listening to Captain Walford's very interesting lectures, I have been particularly struck with the very bad record placed against the shooting of the Nordenfelt gun, it being stated that although it fired 16,000 rounds, only five hits could be found. Now no doubt Captain Walford, in common with most artillery Officers, has a very great contempt for machine-guns, and no doubt rightly and properly has a very firm belief in the value of Shrapnel fire. Now I have personally had great experience with regard to the effect of Shrapnel bullets in the late Turkish war, and also considerable experience as to the effect of the fire of this particular Nordenfelt gun against iron plates, and also rocks and earth, and I wish to point out, that most probably the lecturer, having never seen the effect of Nordenfelt bullets fired against iron plates, or cement, or sand, or earthworks, he is very liable to have been misled, and to have attributed many of the hits due to the Nordenfelt fire to the Shrapnel bullet. The few hits he has mentioned were due to the bullet of the Nordenfelt gun striking the gun directly point on, which would leave an impression on the gun, showing that a pointed projectile had struck it, and so could not be attributed to anything but the Nordenfelt bullet. The Nordenfelt guns were fired against the rifled guns, principally in the embrasures and casemates, and probably nine out of every ten of their shot would have struck the guns at a very acute angle, and would have only left a blurr, more or less serious, according to the angle, which might be easily put down as caused by either pieces of common shell or Shrapnel bullets. It must be remembered that the Nordenfelt shot, at a distance of 2,000 yards, would possess a velocity of some 600 feet or more, and the power of the Nordenfelt gun is exceedingly great in comparison to its calibre. The shot of the Nordenfelt weigh half-a-pound, whilst the Shrapnel bullet has only 200 or 300 feet velocity at a range of 2,000 yards, and a sand shot is only 4 ounces in weight. Of the 261 Shrapnel shells fired by the fleet, 224 were fired at the Mex lines, leaving 37 which were directed against the Ras-el-Tin lines, and Fort Adda, and Fort Pharos, where 30 out of 37 rifled guns were mounted. I doubt if any naval Officer would have thought, for one moment, of firing Shrapnel shell against guns in embrasures and casemates, and therefore the whole of the Shrapnel fire was directed against the smooth-bore guns, which were fired above the parapets. I have risen to mention this, because I think the summing up of the lecturer, in which he states that he has very carefully examined the Egyptian guns, and also all the parapets, more especially referring to those of Fort Adda and Fort Pharos, and that he has put all the marks found in the parapet and the escarp down to the Shrapnel, and of the 8,000 Nordenfelt bullets that were fired at these forts, he says he can find no trace whatever, would produce an impression that the Nordenfelt gun was not as good as it was supposed to be, or else that our naval Officers and men firing these guns were excessively bad marksmen. It is very easy to understand that a Nordenfelt bullet, with its high velocity and weight, on striking a parapet would bury itself 3, 4, or 5 feet, and the probabilities are that after a lapse of three weeks there would be no marks left. The effect of the Nordenfelt bullet striking granite or stone would be very much the same as that of a cold chisel struck by a heavy hammer, it would break off large pieces, and the marks left might, unintentionally, have been put down by the lecturer to the effect of pieces of common shell or Shrapnel bullets. The lecturer has taken a good deal of trouble to show that the effect of the fire from the fleet was exceedingly small, and that it was inconsiderable considering the tremendous fire brought to bear on the Egyptian works. The natural question arises, if the fire was of no use, and did not damage the batteries to any great extent, why on earth did the Egyptian gunners leave their guns? Eye-witnesses who were present at the time said that the gunners could not keep to their guns on account of the rain of machine-gun bullets. The machine-guns fired were the Nordenfelt and the Gatling, at a range of some 2,000 to 4,000 yards, which is beyond the Gatling range. The Gatlings also fire only single shots against the volleys of the Nordenfelt. Probably few of the Gatlings reached, and of course the lead bullets fired from those guns would

not leave any marks at all. I thought it right to offer a few remarks upon this subject to remove the impression that might otherwise exist against the shooting qualities of our naval Officers.

Admiral The Right Honourable Sir JOHN D. HAY, Bart., M.P.: My gallant friend, Sir Astley Cooper Key, did not allude to one portion of the admirable lecture, in which Captain Walford laid down rather hard and fast rules that for the future it would be better for ships in all cases to engage batteries at anchor. I should be very sorry to hear that made an invariable rule of naval tactics. It is quite true where you have not much sea-room, or where there is much motion, it would be the better plan to adopt; but where there is perfectly smooth water, and you have plenty of sea-room, I think there may be occasions in which it would be better to attack with the fleet in motion than at anchor. There is one other point which I wish to allude to for one moment, and that is, with reference to the position of the batteries, as regards their action upon the ship attacking them. It so happened, that I was employed in conjunction with Admiral Ryder, under the late Sir William Reed, then Governor of Malta, in arranging the defences of Malta against a possible sea attack, and my two colleagues came to the conclusion, with which I fully concurred, that it would be a great advantage to have variety of height and variety of distance. Especially for this reason: that after the smoke has begun to obscure the view, there is not so much difficulty for the land battery to obtain a range with which it is familiar, as there is for the ship which is attacking the land battery to vary its range, and therefore that the batteries in support ought to have their distance varied, and their height varied. With reference to the torpedo defences, I will say nothing because they are well-known to all who are here, but I thought it right to mention those points which have not yet been touched upon, so that the lecturer may touch upon them in his reply.

Vice-Admiral BOYS: I only wish to make one or two remarks with reference to this lecture. The gallant Officer has given the armament of the fleet as consisting of eighty-four heavy guns, and from the paper it would appear that all these guns were available to engage at one time, but as there were only two turret ships whose guns could fight on both sides, and the remainder could only use one broadside at a time, the actual number of heavy guns that could engage was only forty-four. The gallant lecturer says, "From these statements I draw the conclusion that in future bombardments it is probable that ships will attack forts at a range beyond the armour-piercing power of ordinary projectiles." That range is so very vague and unlimited, that I do not think it can be considered as a conclusion to be drawn from what happened at Alexandria. I do not say where the ships should be, but I think in future bombardments, it must be left entirely for the Admiral in command to decide his distance, or whether his ships shall fight under weigh or at anchor, according to the circumstances of the case, such as the nature and armament of the batteries or other defences, the proficiency of the garrison as gunners, and the navigable condition of the locality. If the Government provide Officers in command with the different descriptions and types of vessels required, it must be left to them to appropriate those ships to the special duties for which they are most suitable, especially as to range. With regard to the Nordenfelt guns, I would observe they were engaged at a very long range. The lecturer thinks one thing as to their effect, Lieutenant Sleeman thinks another. No one can really tell what the effect was, except those who were actually in the batteries at the time, and it would be very instructive and interesting if we could possibly get information from some intelligent Officers or men who were engaged in the batteries, as to what was the effect of the machine-gun fire, and what bearing it had in silencing the fire of their guns. With regard to the relief reserves, I think the lecturer has said that the heavy guns require more reliefs on account of the labour attached to working them. I do not quite agree with him, because, whether a soldier or a sailor is working a 6-pounder, or an 80-ton gun, he is exerting himself to the utmost all the time, and one does not want relief more than the other; they are necessary for both.

General SCHOMBERG, R.M.A.: I hope I may be allowed to make a few remarks. In the first place, I should like to ask two questions. The lecturer has spoken of the character of the fire from the ships. I should like to ask some of the naval Officers

present who were in action at the bombardment, if they would give us some account of the kind of fire; was it simply independent firing, or was there any attempt to use electric firing? I should like also to ask a question about the construction of the Egyptian parapets; were they constructed of earth or sand? I quite agree with Sir John Hay's remark, with regard to the first point, which the lecturer deduces at the conclusion of his paper. "It is of importance that the batteries for coast defence should have a considerable command over the sea; but should not be conspicuous objects on the coast." I also think it would be a very great advantage to have them dispersed; for instance in defending such a place as Plymouth, if the batteries were scattered, it would be impossible for ships to concentrate their fire upon them. I think No. 4 is a most important point: "Great care must be taken to render the magazines and stores absolutely secure, and also to provide bombproof cover for the garrison." I think also, if possible, there should be cover for the number of gun detachment who are not actually at work in rear of the gunslide. The suggestion as to the counter-guard also appears to be most important. With regard to No. 7: "Each gun should be divided from its neighbour by a bombproof traverse, and a parados should be provided in rear of each battery." I think it is of the utmost importance that heavy guns should be divided from each other; many of the batteries of older construction, such as at Plymouth, would be considerably strengthened by removing every other gun, and constructing an iron traverse in its place; not so much for protection for the gunners as to prevent noise and confusion, so that the gun detachment might be perfectly undisturbed at their work. They would be firing at ships in rapid motion, and nothing should interfere with them, or distract their attention. No. 12 states: "The guns should be pivoted well forward, and their muzzles should but just clear the sole of the embrasure when the gun is horizontal." That seems to me a very good suggestion also. As to the parados (No. 7), I quite agree that it should not be a shell-trap, but I think if it were removed a sufficient distance from the gun detachment, it would be most valuable, and would, as the lecturer says, protect any barracks or other construction in rear of the battery from being hit by stray shell. "The system of reliefs must be arranged for the gun detachments." I quite agree with the lecturer on this point. I have been at work for forty-two hours consecutively, and I know the tremendous strain it is on sinews and brain to work so long. I think his arrangement of three detachments is very good, but I would keep them longer than one hour at work. "Some system better than the present should be provided for traversing the guns." I perfectly agree with this; I think that hydraulic power probably might be so employed, but in the event of any such power becoming disabled, there should always be a probability of falling back on tackles or cogwheels. "Some provision should be made for the possible use of vertical fire against ships." I am afraid we are very much neglecting vertical fire. When shell guns were brought into common use, the same mistake was made. We fancied everything was to be done by horizontal fire; and in consequence, at the siege of Sebastopol, there was a vast waste of ammunition. It seems to me we are repeating the same mistake, we are not paying sufficient attention to vertical fire. But its employment against single ships will usually result in a wasting of ammunition, though, as the lecturer observes, it may be very useful in forcing ships to engage batteries under weigh. However, the legitimate employment of vertical fire is against larger objects, such as arsenals or fleets. A sufficient number of mortar-boats armed with rifled mortars, if it did not destroy, would at any rate considerably damage any fleet collected behind such a breakwater as Plymouth, for instance. There may be an idea that the rifled mortar will prove to be more accurate than the old mortar. My opinion is, the new mortar will only be more accurate in direction, and, that its variation in range at high angles of elevation will be much the same as that of the old smooth-bore.

The CHAIRMAN: In closing this discussion I think it right to say one or two words merely on the general subject. I am very glad that my gallant friend, Sir Cooper Key, made the remarks he did about the "bombardment of Alexandria." I consider it is an improper term, and I consider that we never did bombard Alexandria, though we did bombard some of the forts of Alexandria. It is perfectly correct, as the noble lord said, that Lord Granville made those remarks, but he made them

exactly in the spirit and sense in which the gallant Admiral made them. That there was a bombardment everybody knows, but the bombardment was of the forts, and the lecture has shown that there were only one or two shells that actually fell into the town of Alexandria, and those purely by accident, showing the great attention paid by everybody on board, in order to avoid the possibility of any such accident happening as the bombardment of the town of Alexandria. I look upon this as of great national importance, because it is one of the things that has often been stated, that we had no right to go and bombard a town like Alexandria. We never did bombard Alexandria, it was the forts that we bombarded, and why? Because they were a danger to the fleet, which we were obliged to keep there, and it being so, we were justified in bombarding that which put our fleet in danger. On that ground I contend, whilst we were perfectly justified in doing the one, we should have been extremely wrong to have done the other, and the lecturer has, through his ability, shown us most forcibly that what I am now stating is exactly what took place. I think this fact reflects the highest credit on the Admiral and the Officers of the fleet, and when we are told that the fire was bad and irregular, I entirely disagree with the statement. I say the very thing I am pointing out proves that the fire was good, that it was well directed, and why? It is ridiculous to suppose that every shot is to hit in the exact place anticipated, it is impossible; distance, light, everything shows that there must be great doubt and uncertainty, and when we look at what has occurred, I think we must say that on the whole the fire was extremely good. And you must remember another thing, that the fire in action is a very different thing from firing at the butts at Shoeburyness. There you stand in great comfort, you have every means and appliance at your command, but in action you must take the things as they come. It is a very different thing from preparing for hours and days beforehand in order to produce a good shot, or to let your shell drop exactly where you want it. And I say, taking all in all, I think we have had enough to-day to satisfy us that the principle upon which our naval gunnery is conducted is sound and wise. As regards the forts, I beg entirely to agree, as far as I can judge, with the conclusion that the lecturer has arrived at, that earth forts as against batteries are decidedly very superior to stone or any hard material. You must always bear this in mind, that there are a great many instances in which you cannot have earth, and you must have stone; therefore, you must not assume that because as a rule, and as a principle, it is sound and wise to adopt, where you can, the earth, it is not as a natural result necessary occasionally, often, to have stone or stronger material. For instance, in forts in the sea, sometimes you could not make them of earth. Therefore, with that reservation, I think that wherever it can be done, the most efficient sea batteries as against a fleet are decidedly earth batteries. Even as long ago as when we were in the Crimea, I remember it was the "Wasp" battery—not a stone battery but an earth battery—which did our fleet more damage than many of the fine batteries standing round in every direction. I think it will be found that we felt that even then, and no doubt what we know now only confirms that point. There is one other point I am very glad to refer to. No man has a higher opinion of the Royal Navy than I have; no man has a higher opinion of the great fighting element that it is to this country; but I am quite satisfied from what we have heard to-day that the navy thinks that forts are very uncomfortable enemies to deal with, and whilst we are a great naval Power, we should certainly not neglect the fact that all our ports have vulnerable points, and that where those vulnerable points exist, it is worth while that money should be spent in order to put up proper forts to defend them. This is a very important subject for two reasons; first of all, forts are very expensive; and it is well known that when it comes to a matter of expense, people are apt to dislike to meet it. If you do not meet the expense, what is the result? That your navy cannot produce the effect which it would do, if it had those forts to back it. If it were not for the forts to hold these points, the navy would not be free to move about in various directions and cover the oceans. Those two points are of such importance, that I think it is essential we should not forget, that whilst we are a naval Power and are grateful to be in a position to retain our naval superiority, that that naval Power must be backed by military positions, such as have to be defended by forts, and that the forts are a great element in our naval

superiority. I am sure we are all very much obliged to the lecturer for the admirable lecture that he has given us to-day.

Lord WAVENEY: I am sure your Royal Highness will allow me to say that when I spoke of the "bombardment of Alexandria," I spoke of it in the same sense in which Lord Granville spoke of it. I imagined that I expressed myself in those terms. I did not at all wish to say that it was a bombardment of the town, but simply that it was a bombardment of the forts.

The CHAIRMAN: I am very sorry if I misunderstood it, but certainly I fancied that the noble lord did not agree with the gallant Admiral; that was my impression.

Captain WALFORD, in reply, said: With regard to what Lieutenant Sleeman said as to the Nordenfelt guns, I am sure that no one who had seen a single mark of a Nordenfelt bullet, at Alexandria or elsewhere, could fail to know it again. I could only compare it to the mark of the Palliser shell. The Nordenfelt bullets which we noticed had produced very great effect, but I can safely say, that on no other gun in Alexandria was there a single Nordenfelt mark, except those which I have mentioned. With regard to the parapets, they were not earth, they were sand and covered with cement; that is to say, every shot that struck that cement marked it, there could be no mistake about it. The escarps were covered with cement, and in the case of those escarps which I have mentioned, I picked the Shrapnel bullet out of the cement myself. It was reported to me by an Officer of the navy, that the gun in the Hospital battery had been struck by a Nordenfelt bullet. I went to look at the gun and I was sure at once that it was not a Nordenfelt. The deepest hole was hemispherical, and ½-inch deep. The shallowest of the Nordenfelt hits we found, was somewhere about 1-inch deep, and certainly not hemispherical. I was so convinced that these were Shrapnel bullets, that I stayed ten minutes or a quarter-of-an hour with that gun. I traced the bullet, and eventually dug it out from the front of the carriage, and it was a Shrapnel bullet; I have it here. My own belief is, that the Nordenfelt is an excellent gun, but that the range was too long for it. I should wish to say, I do not consider the effect of fire from the navy was by any means small; I consider it was very great indeed. The amount of destruction done in the forts was absolutely surprising. The quarters, and stores, and buildings in the rear were demolished. All I say is, if the parapets of modern forts are made of a reasonable thickness, say 30 feet, I do not think any shells which the navy will fire need drive the gunners away from their guns.

NAMES OF MEMBERS who joined the Institution between the 1st January and 1st April, 1883.

LIFE MEMBERS.

Hoskyn, R. F., Lieut. R.N.
Hammick, R. F., Commander R.N.
Harfield, W. H., Lt.-Col. Middx. Yeo.
Everitt, S. G., Lieut. Royal Welsh Fus.
Egerton, G. G. A., Lt. Seaforth Highs.
Ross, J. J., Major h.-p. late 13th Regt.
Nairne, C. E., Lieut.-Col., C.B., R.H.A.
Harrison, C. E., Lieut. Rl. W. Kent Rgt.
Greatwood, H. F., Lt.-Col. late E. Surrey Regiment.
Hordern, L. H., Lieut. R.N.
Lambert, C. J., Esq., M.A., F.R.A.S.
Warren, H. A., Lieut. R.N.
Hickes, H. J. F. E., Colonel R.H.A.
Newdigate, F. A., Lieut. Cold. Gds.
Bolitho, O. G., Major 3rd Dragoon Gds.
Lang, E. L., Lieut. R.N.
Kane, H. C., Capt. R.N.
Grey, G. A. G., Commander R.N.
Thompson, L. C. F., Capt. the King's Regiment.
Broadwood, Francis, Lieut. S. Stafford Regiment.
Evans, E. R., Capt. Rl. Welsh Fus.

ANNUAL SUBSCRIBERS.

Dobbs, G. C., Capt. Bo. S.C.
Starr, G. L. H., Capt. Innis. Fus.
Griffiths, C., Lieut. York and Lanc. Regt.
Frederick, C. A. A., Lieut. Cold. Gds.
Gardiner, S., Major R.A.
Goldfrap, H. C. S., Capt. Linc. Regt.
Kingsford, H. C., Lieut. R.N.
Connolly, E. M., Major-General.
Burton, H., Lt.-Col. 3rd Mon. Rifle Vols.
Stevens, A. J., Capt. 3rd Mon. Rifle Vols.
McKay, J., Major-General.
Poe, E. S., Commander R.N.
Jeffreys, W. R., Lt.-Col. late R.M.L.I.
Fox, H. C., Capt. 3rd Batt. Rl. Fus.
Payne, E., Commander R.N.
Sandford, H., Lieut. R.N.
Manners, C. G. E. J., Lieut. Gren. Gds.
de Burgh, U. G. C., Capt. 7th Drag. Gds.
Gordon, W. E., Capt. R.N.
Halford, C. H., Lieut. Gren. Gds.
Randall, J. H., C.B., Commissary-Gen.
Morris, Sir E., K.C.B., Commissary-Gen.
West, M. R., Major R.A.
Conor, C., Major West Riding Regt.
Thomas, A. B., Capt. R.N.
Finch, W. J., Lt.-Col. R.A.
Richards, S. S. C., Lt.-Col. Bloomsbury Rifles.
Middleton, R. W., Lieut. R.N.
Helby, H. W. H., Mid. R.N.
Erskine, J. F., Lieut. Scots Gds.
Groves, E. A. W. S., Major Rl. W. Kent Regiment.
Richards, Sir Frederick W., K.C.B., Rear-Admiral.
Dineley, F. G., Mid. R.N.
Hamilton, P. F., Capt. R.A.
Jackson, H. K., Lieut. R.A.
Moon, W. G., Lieut. 4th Bt. E. Surrey Regiment.
Stuart, H. B., Esq., late Bengal Army.

OCCASIONAL PAPERS.

This portion of the Number is reserved for Articles, either Original or Compiled, on Professional Subjects connected with Foreign Naval and Military matters; also for Notices of Professional Books, either Foreign or English.

It is requested that communications or books for review may be addressed to Colonel Lonsdale Hale, at the Royal United Service Institution, Whitehall Yard, London, S.W.

THE RUSSIAN ARMY IN 1882.

Die Russische Armee in Krieg und Frieden nach den neuesten Reorganisations-Bestimmungen und anderen Quellen dargestellt. Von A. v. Drygalski, Königl.-Preuss. Premier-Lieutenant A.D. Berlin, 1882.

"The Armed Strength of Russia." Compiled in the Intelligence Branch of the Quartermaster-General's Department, Horse Guards. War Office, London, 1882.

"Revue Militaire de l'Etranger" (Nos. 543, 561, 563, 565, 567). This valuable periodical furnishes us with details of all changes made in the Russian Army since the publication of the two above-mentioned works, thus enabling us to correct a certain number of statements contained in them, which were doubtless accurate when made, but have now ceased to be so.

No army in the world has probably undergone, within the last thirty years, such a succession of extensive alterations in organization, in administrative arrangements, and in tactical regulations as that of Russia. The Crimean war surprised it during a period of transition. Further changes of importance were carried out after that war. Once more, in 1874, the whole military system was remodelled, whilst ever since the peace of San Stefano radical reforms have been in progress, and have, during the latter half of 1881, as well as during the whole of 1882, been prosecuted with such feverish haste that it is difficult for the observer to keep pace with them; as an instance of which we may mention the fact that the latest edition of the Manual published, at uncertain periods, by the Russian Government for the benefit of officers, having appeared in the summer of 1881, much of the information contained therein is already obsolete, a great number of most important regulations having meanwhile been altered. Some further changes of no little consequence have been made since the publication of the first two works above mentioned, upon which the present article is chiefly founded—a remark which particularly applies to the valuable compilation issued by the British War Office; changes in matters of detail are still being made, and further minor changes will doubtless continue to be made; but, as the whole framework of the new Russian military system seems at length to be firmly constructed, the season appears to be a favourable one for taking a survey of the Russian Army as known to us in 1882.

First of all let us glance at the extent and resources of the empire which that Army has to protect.

The Russian Empire.

	Area in square miles.	Population.
1. *European Russia:*		
Russia proper	1,895,486	65,849,610
Kingdom of Poland	49,158	6,528,017
Accession in Bessarabia (1878)	3,274	127,000
Grand Duchy of Finland	144,226	1,941,255
Cis-Caucasus	87,100	1,836,694
	2,179,244	76,282,576
2. *Asiatic Russia:*		
Trans-Caucasia....	82,475	3,555,050
Accession in Armenia (1878)	9,950	576,747
Siberia	4,824,479	3,440,362
Central Asia	1,305,461	4,505,876
	6,222,365	12,078,035
3. *Grand total Russian empire*	8,401,609	88,360,611

The estimate of population is only approximate; it is based upon the census of 1871, and modified by subsequent calculation. The last census was taken in 1880, but the results have not yet been published. The population of the empire may be set down, in round numbers, as 90,000,000.

It is very unequally distributed throughout the empire, there being an average of 35 inhabitants per square mile in European Russia and only of 1·94 per square mile in Asiatic Russia.

The most thickly populated districts are the central provinces, "Great" and "Little" Russia, West Russia, and Poland; "but the provinces to the east and north-east of these districts have comparatively few inhabitants on account of their severe climate and poor soil, while the great trackless steppes to the southward are equally unsuited for maintaining a large population."[1] The great mass of Russians are agriculturists. There are only ten cities containing more than 100,000 inhabitants, including St. Petersburg, 670,000; Moscow, 602,000; Warsaw, 337,000; besides which there are eighteen towns with a population ranging between 40,000 and 86,000. There were 14,151 miles of railway open for traffic in July, 1880 –the last date for which we have any official returns. Railway construction was only commenced in earnest in 1862, chiefly for military reasons; and the tracing of the several lines has been influenced more by strategical than by commercial considerations. The rate of progress has of late years been rapid, averaging about 700 miles annually opened to traffic. Much, however, remains to be done before Russia can occupy as advantageous a position in this respect as the other European nations; for instance, Great Britain and Ireland, which, with an area of about 120,000 square miles, had, in 1880, 18,049 miles of railway in operation; and what more immediately concerns Russia, especially from the military point of view, one of her immediate neighbours, the German empire, with an area of 210,000 square miles, has 21,170 miles of railway, and the other, Austria, with 228,000 square miles, has 11,690 miles of railway. Russia, with her area of 8,000,000 square miles and 14,000 miles of railway, compares unfavourably with the adjacent empires—a circumstance which must enter largely into the calculations of her statesmen. Inland navigation is, on the other hand, widely developed, and may be of military importance under certain circumstances. There

[1] "Armed Strength of Russia."

is direct water-communication between the Caspian Sea and St. Petersburg, a distance of 1,434 miles, chiefly by the Volga, but partly by canal. "There are four steamboat companies that navigate the Volga with first-class river steamers; this noble river running a course of 2,000 miles without a rapid, whirlpool, or sandbank."[1] The total extent of inland navigation is as follows:—canals, 865 miles; navigable rivers, 18,935 miles; total, 19,800 miles. Although, as we have seen, much has been done of late years in the way of railway extension, the roads appear to have been but little improved, and to be still, as a general rule, atrocious.[2] When we consider the severity of the climate in the greater part of Russia, the enormous distances which separate the principal centres of population and of government from each other, and from other parts of the empire, and, lastly, the very insufficient means of communication which exist, we are able in some measure to appreciate the great difficulties encountered by those responsible for the organization, instruction, and mobilization of that vast machine, the Russian Army—difficulties which meet them at every step, and which must, as far as we can see, always prevent that Army, no matter how able its administration may become, from being equal as a fighting machine to that of its great western neighbour.

Imperial Revenue and Expenditure.

(From "Armed Strength.")

		English equivalent at full silver value of rouble.	English equivalent at depreciated value of paper rouble.
I.	Total Revenue. *Roubles.*	£	£
1879	661,954,192	104,938,657	68,953,561
1880	651,016,683	103,204,793	70,526,807
1881 .. (estimate)	717,461,609	113,738,181	74,735,583
1882 .. (estimate)	762,004,512	120,799,543	82,550,489
II.	Total Expenditure. *Roubles.*	£	£
1879	643,892,258	102,075,363	67,072,109
1880	694,505,313	110,098,987	75,238,076
1881 .. (estimate)	717,461,609	113,738,181	74,735,583
1882 .. (estimate)	762,004,512	120,799,543	82,550,489
(According to Drygalski)	658,595,151		
III.	Army Expenditure. *Roubles.*	£	£
1879	187,451,193	29,716,381	19,526,165
1880	208,577,436	33,065,499	22,595,889
1881 .. (estimate)	206,715,302	32,770,707	21,533,156
1882 .. (estimate)	183.489,042	29,088,270	19,877,980

According to the regulations promulgated in 1873, the normal expenditure on the Army was fixed at a maximum of 179,290,000 roubles, which amount was not to be exceeded except by special sanction of the Czar.

This comparatively low rate of expenditure was, however, only adhered to for a very short period; and from 1876 onwards we find that supplementary

[1] "Progress of the World" (Mulhall). There are now (1883) six steam companies for passengers, besides several for "tugs."—(L.G.)

[2] "Russia," by D. Mackenzie Wallace. Vol. I, pages 20–24.

credits were granted, bringing up the Army charges to the high rates shown in Table No. III. This increase in expenditure is independent of money raised to carry on the late war against Turkey to the amount, according to official statements, of £130,000,000.[1]

The present Emperor, alarmed at the enormous cost of the War Department,—a cost which the resources of the empire seemed inadequate to meet—determined upon a course of vigorous retrenchment, and ordered a considerable reduction of the peace establishment (from 863,000 men to 756,000), and various other minor economies, thanks to which the Army budget of 1882 shows, as we have seen, a reduction of 23,229,260 roubles. Reasoning from previous experience, we are inclined to doubt the permanency of this fit of economy; at any rate it appears probable that no further reduction of expenditure is likely to be carried out, as it is intended to improve the position of the non-commissioned officers and private soldiers by giving them higher pay and better quarters, also to provide ranges for target practice,[2] riding-schools, &c.

Already, too, the estimate for pay and allowances of officers was increased in 1881 by the sum of 1,571,000 roubles, although the strength of the Army had been reduced by 107,000 men, with a proportionate reduction of officers. It is hoped that this and other proposed additions to Army expenditure will be balanced by economy in other respects, and that if peace is maintained, and the same principles are applied to all the public services, the deficit will in a few years be converted into a surplus. The large reduction in the peace establishment of the Army, though doubtless beneficial to the revenues, and probably, for financial reasons, absolutely necessary, is somewhat detrimental to the military strength of Russia, as it reduces the number of trained soldiers who will pass annually into the reserve—an event which will make itself all the more felt if the intention now entertained is carried out of increasing the length of service by one year in both infantry and cavalry.

The Conscription.

The military system of Russia is based upon the principles of universal liability and of territorial distribution.

The imperial ukase of the 1st January, 1874, at present regulates the recruitment of the Army, being applicable to all parts of the empire except the Grand Duchy of Finland (population in 1879, 2,028,021), the Cossack regions (male population in 1880, 1,110,000), and lands occupied by certain foreign races in Trans-Caucasia and other remote parts.

The following are the main provisions of the regulations affecting the land forces, issued in accordance with the ukase above referred to :—

The entire male population, without distinction of class, is liable to military service.

Exemption, by purchase or by obtaining a substitute, is prohibited, except in the case of a brother or cousin under certain conditions.

The number of men required for the annual contingent is fixed by the legislature every year on the recommendation of the Minister of War, and is promulgated to the Senate by imperial ukase.

[1] "Progress of the World."—MULHALL.

[2] Budgets being, so to say, retrospective in Russia, that of 1882 is as yet unpublished, and we know not what saving, if any, was effected; but the following further items of extra expenditure must militate against economy:—1. The new dress, which requires more cloth, and entails a more expensive cap. 2. The contemplated increase of 50 per cent. to the Cavalry, and that to the Horse Artillery. 3. The fortifications of Kovno and the Polish Triangle, with connecting railroads. 4. The cavalry concentration under the Grand Duke Nicholas. 5. The Transcaspian works.

Admission to the service, or exemption therefrom, depends upon the number drawn by the individual, every man declared liable and fit to serve having to take part in lot-drawing once during his lifetime. Those who are exempted by drawing so-called "lucky" numbers are enrolled in the "Opoltchenié," of which more hereafter.

One class only of the population is annually called upon to take part in the drawing, namely, that including all men who have attained the age of twenty on the 1st January of the year in question.

Persons who have fulfilled certain educational requirements may relieve themselves from lot-drawing by enlisting as volunteers under conditions to be hereafter specified.

The annual levy of recruits for the active Army has hitherto taken place in Europe between the 1st November and the 15th December, and in Siberia between the 15th October and the 31st December; but it is intended that in future all recruits shall join on the 1st December, so as give them more time for preparatory drill.

The ordinary duration of service is fixed at fifteen years, of which six with the colours and nine with the reserve; but, in the case of men serving at some of the more distant Asiatic stations, the total length of service is reduced to ten years, of which seven with the colours and three in the reserve.

In time of war men can be retained with the colours as long as required.

The Minister of War has by law the power of sending any private soldier to the reserve before the completion of his active service, and it has been the custom of late, from motives of economy, only to keep men four years with the colours; but it is intended that in future the actual terms of active service shall be prolonged in the case of infantry and garrison artillery to five years, and in the case of all other branches of the Army to the full period of six years.

Reduction in the length of active service is also made on account of educational proficiency as follows:—

1. To six months (about to be raised to eighteen months) with the colours, and fourteen and a half years in the reserve, in the case of men who have taken university degrees or who have passed equivalent examinations.

2. To eighteen months with the colours (about to be raised to three years), and thirteen and a half years in the reserve, in the case of men who have finished a certain specified course in a gymnasium or second-class school.

3. To three years with the colours (about to be raised to four years), and twelve years in the reserve, in the case of men who have passed through a third-class school.

4. To four years with the colours, and eleven years in the reserve, in the case of men who have passed through a primary or fourth-class school—in other words, who can read and write.[1]

Exemptions.

The exemptions may be divided into two principal classes:—

1. Those entirely released from military liability, who may be again subdivided into—

(*a*) Those exempt for family reasons, which are many and various, and

[1] Education has made considerable progress in Russia since the emancipation of the serfs; for whereas in 1860 only two per cent. of conscripts could write, in 1870 the proportion had risen to eleven per cent. (*vide* "Progress of the World," Mulhall, page 380). The same authority, however, states that in 1880 there were 1,500,000 children at school—a small number for such a vast population, and showing no great increase over the number of scholars returned in 1867, namely, 1,155,773 (*vide* "Statesman's Year Book," 1870).

similar to those admitted in other countries where conscription is in force.

(*b*) The clergy of all Christian denominations, and singers in Orthodox churches who have completed a course of study at an ecclesiastical academy. Persons, however, who resign their duties in the Church after a period of six years are enrolled in the reserve : if they resign before this term, they become liable for duty with the active Army.

2. Those released from liability to serve in peace time, and enrolled for fifteen years in the reserve, and with the obligation to serve in war time if required.

This class includes all members of the medical profession ; exhibitioners of the Academy of Fine Arts ; also professors and other instructors in public schools and colleges.

Postponements.

Individuals who personally manage their estates, or direct their own commercial or industrial establishments (*with the exception of vendors of strong liquors*), may have their entry into the service postponed for a period not exceeding two years.

Students in certain educational establishments are, if they wish it, allowed to postpone taking part in the drawing for periods ranging from two years to eight years, according to the nature of their studies, to their proficiency, and to the class of establishment at which they are being educated.

All such students are allowed also to declare, two months before the time of lot-drawing, whether they wish to enter the service as volunteers, in which case they are relieved from the drawing, and are allowed the same indulgence as to postponement of service.

Volunteers.

Men can enlist voluntarily under the following conditions :—

They must be at least seventeen years old.

If minors, they must have the consent of parent or guardian. They must be physically fit, and must have complied with certain educational requirements.

Enlisted volunteers are divided into three classes—

1. Those who have passed through a first-class establishment ;

2. Those who have passed through a second-class establishment ;

3. Those who have passed the special examinations appointed by the authorities.

Class 1 need only serve three months with the colours.

Class 2 is retained six months.

Class 3 must remain two years.

All volunteers serve nine years in the reserve. They may enter the service at any time of the year. Only a limited number is allowed in each corps or regiment. Those joining the Guards or the Cavalry must maintain themselves at their own expense. Those who wish to do so, may live in private quarters, except when in camps of instruction. They all join as privates, and perform all the duties of the same, with certain exemptions. Those who can pass the required technical examinations may, with the consent of their commanding officer, be promoted to the rank of non-commissioned officer after two months' service, if belonging to the 1st Class ; after four months' service, if belonging to the 2nd Class ; and after one year's service, if belonging to the 3rd Class.

First-class volunteers, after serving three months as non-commissioned officers, may be promoted to the rank of Officer ; those of the second class,

after six months; and those of the third class after one year; but no such promotion can take place unless the candidate has served in camp during at least one period of exercise.

Students at the various military schools are considered to be enlisted volunteers; time spent in the schools counting as service with the colours.

There is another kind of volunteer, called "Okhotnik." He must be under thirty years of age in peace, and under forty in war, and not be liable to conscription.

The terms of service are the same as for other recruits.

Results of the Conscription in 1878.

I.	Total number of men attaining the age of 20....	759,055
II.	Number of men actually enrolled for the Army	207,691
	" " " " Navy	5,396
	Total contingent	213,087

Exemptions, Postponements, &c.

	Exempt for family reasons	388,384
	Passed direct into the reserve	1,142
	Struck off lists	15,806
	Exempt by purchase under old regulations	711
	Rejected	46,038
	Granted postponement on various grounds	2,852
	Sent to hospital for treatment	6.380
	Put back to next year	51,269
	Deficiencies in local contingent	3,060
	Failed to appear	27,190
III.	Total exemptions, &c.	542,832
	Add together II and III	755,919
	Subtract II and III from I, there remains a surplus passed direct into the "Opoltchenié," &c.	3,136

General Results of the Conscription in 1879.

Total number of men attaining the age of 20	794,000
Total contingent demanded for Army and Navy	218,000
Recruits medically inspected	265,750
Of whom, rejected as unfit (21·9 per cent.)	58,150

General Results of the Conscription in 1880.

Total contingent demanded for Army and Navy	235,000
Total number of recruits enrolled	231,961

There was a deficit of 3,309 men, of whom 3,000 were Jews.

In September, 1881, in consequence of the reduction of the peace establishment, the annual contingent was reduced to 190,000, with 22,000 additional who are only to serve one year, on account of family reasons—a class of soldier which it is intended to increase.

Standard of Height.

Corps.	Height.	Other Qualifications.
	Ft. Ins.	
Guard, all arms, including sailors	5 6½	Picked men.
Grenadiers	5 4¾	Selected after the Guard.
Rifles	5 1¼	Not over 5 ft. 4¾ ins. Broad-shouldered in proportion.
Cavalry of the Line	5 4¾	Not over 5 ft. 10 ins. Build suitable for horsemen; short-legged, bow-legged, and knock-kneed men not taken.
Artillery	5 4¾	Strongly built. Half of the Horse Artillery must be 5 ft. 8¼ ins.
Engineers	5 1¼	Broad-shouldered. If possible, smiths, carpenters, or such like.
Gendarmes	5 4¾	Only men who have to serve the full six years taken. Other qualifications as for Cavalry.
Customs Guard	5 3	Good sight and hearing. Other qualifications as for Cavalry.

After providing for the wants of the special corps named in the above Table, the best of the remaining recruits are allotted to the Infantry, the Reserve Infantry, and the Convoy Detachments. Men over 5 ft. 4¾ ins. are not posted to a local corps. Conscripts, not fit for service as combatants, are posted to corps as non-combatants.

In 1875, about 75 per cent. of the Russian Army were Russians proper. 79·47 per cent. of the conscripts were totally illiterate, and 75 per cent. were peasants.

Jews are not admitted into the Fortress Artillery, Local Battalions, Convoy Detachments, Customs Guard, or Navy. Mahomedans are not taken for troops serving in Turkestan.

European Russia, except Poland, the Baltic provinces, and Finland, is divided for recruiting purposes into 164 districts, answering to the number of line infantry regiments, each of which is recruited in its own district. Other corps are recruited throughout the empire.

Poland and the Baltic provinces are divided into districts; but the recruits raised in them are distributed throughout the Army, composing about 20 per cent. of the strength of each regiment. The Grand Duchy of Finland has military laws peculiar to itself.

The present law of conscription, as affecting the empire generally, will not produce its full effect till 1889, when, supposing the annual contingent now fixed by law to have been in the meantime maintained, and allowing the usual annual per-centage for casualties, the number of trained soldiers available for the regular Army will nearly amount to 2,600,000. In the present year it is estimated at 2,145,000.

Although the Guards get the pick of the recruits, and after them the Cavalry, Artillery, Engineer and Rifle battalions have the choice, yet the Infantry, too, is composed of right good material, although varying a good deal in appearance and physique, according to the districts from which it is recruited. In addition to the ordinary conscripts, there are in the ranks a certain per-centage of men who, having obtained the necessary educational certificate, have the right to choose the corps in which to serve, either for six months or for eighteen months, according to their degree of education. Then,

again, there are men who volunteer, and who belong to one of the three first classes (as to education); these have to serve, according to their class, either three months, six months, or two years; and, thirdly, the so-called *Ochotniks* (corresponding to the German three-year volunteer), who have the right of selecting their corps, but must soldier for four years. From the last-named class most of the non-commissioned officers are drawn. Latterly, another class of soldier has been introduced into the service, namely, those who, on account of family reasons, are only required to remain one year with the colours, after which they pass for fourteen years into the reserve.

But, after all, the great majority of the recruits are those who have drawn their number, and who have to serve the full period. They are generally very illiterate. Of 231,677 men enrolled in 1880, only 243 had 1st class certificates; 394 had 2nd class; 1,465, 3rd class; and 1,897, 4th class: that is to say, there were 3,999 men with some education. Only 20 per cent. of the whole contingent could read and write.[1] However, this want of education among the conscripts is a good deal remedied by the company schools which all soldiers have to attend after their first year's service, and by the regimental schools for non-commissioned officers, thanks to which, many a youth who joins utterly without education gains sufficient knowledge to qualify him for the post of non-commissioned officer, and not a few make sufficient progress to gain admission to the Cadet schools and to pass the Officers' examination.

Still the great majority remain at a very low level as to education—an evil which is, however, less detrimental than it might be to efficiency, in consequence of the natural quickness and intelligence of the Russian peasant, combined with adroitness in all manual labour, particularly in carpentering and spade-work; besides which, he is, as a rule, willing, amenable to discipline, hardy to an extreme, brave and devoted to his leaders, all which qualities tend to make him one of the best soldiers in the world.

In Russia, as elsewhere, the difficulty of keeping up an efficient body of non-commissioned officers has made itself felt of late years more than in former times, partly owing to the reduced period of service, and partly to the increased advantages offered by other careers, in consequence of which few men re-engage, notwithstanding the considerable allowances and privileges to which they would become entitled by doing so; and most of the good men who get promoted to the rank of non-commissioned officer after two years' service do not retain their position as such more than a year, after which they take their discharge. There is, therefore, an idea of holding out still greater inducements for them to remain, and also of establishing non-commissioned officers' schools, after the German pattern. In the meanwhile, the peace establishment of non-commissioned officers has been much reduced, and none but re-engaged men are made sergeant-majors, quartermaster-sergeants, or sergeants, whilst the others can only become corporals, of whom there is but one per company on the present peace establishment, the three other non-commissioned officers of this grade who formerly existed being now replaced by lance or acting corporals. The reserve is amply sufficient, as far as mere number is concerned, to supply the additional non-commissioned officers required on mobilization.[2] The supply of Officers will be treated of separately.

Special Conditions of Service for the Grand Duchy of Finland.

The Grand Duchy of Finland was ceded to Russia by Sweden in 1809 under conditions which preserve to it its ancient constitution, dating from the year 1772, under which the right of legislation and of taxation was in the hands of a National Assembly. In 1817, however, the Emperor Alexander I formed a Senate of three members which distinctly controlled the Assembly. In 1812

[1] At the manœuvres of 1882, however, a British Officer was informed by Russian regimental Officers that only from 5 to 6 per cent. of the men could read and write.

[2] It is said that men who have served their time with the colours rarely return to the plough, but settle in towns.

the office of Governor-General of Finland was created, the whole executive power being vested in this officer. In 1816 the Imperial Senate of Finland was established—a body first of twelve and finally of eighteen members, nominated by the Emperor, and serving for three years. The Grand Duchy is now governed by this Senate, which takes its orders from the Emperor through a Secretary of State for Finland residing at St. Petersburg; but the National Assembly still exists, and passes laws *submitted* to it by the executive. A bill for the introduction of general service was carried in the Assembly and published in 1879.[1] It took effect from 1st January, 1881. Its general provisions are as follows:—

1. Every Finn is liable to render military service after completing his twentieth year.
2. The military force consists of active army, reserve, and general levy (Opoltchenié). According to the number drawn, a conscript is enrolled in one or other of the two former bodies.
3. The contingent is voted annually by the Senate of Finland.
4. The inhabitants of the Lappmark, in the district of Uleaborg, are excused from service until further notice.
5. Men enrolled in the active Army serve in it for three years, after which they serve two years in the reserve. Those enrolled in the reserve spend the whole five years in it, being called out for training during the first three years, or for ninety days in all.
6. Soldiers of the active Army get three months' furlough annually, and even a longer period during their third year's service.
7. The reserves are called out by order of the Emperor, communicated by the Governor-General.
8. The reserve men raise the field troops to war strength, form separate reserve divisions and cadres for the "Opoltchenié."
9. After passing through the reserve all men belong to the Opoltchenié until forty years of age.
10. The Opoltchenié is called out by imperial ukase, and can only be employed for home defence. It is formed into separate battalions, and is subject to military law when embodied. None of its members can be drafted into regiments of the active Army.
11. Regulations regarding exemptions, postponements, and volunteering are almost identical with those applicable to the rest of the empire.

The Command and Administration of the Army.

The Emperor is Commander-in-Chief. His orders are issued through the War Office, in which there are twelve departments:—

1. The War Ministry, whose head receives his orders direct from the Emperor, and is responsible for the general efficiency of the Army. He submits all matters of great importance to the sovereign, signs imperial decrees, and issues regulations. He has the right of inspecting all bodies of troops and military institutions. The War Minister is assisted by a staff of executive officers. There are in the office sections for staff diary, records and accounts, and a solicitor is attached to it.

2. The *Imperial head-quarters*, under a General Officer as Commandant, who, in the absence of the War Minister, takes the Emperor's orders and sees to their execution. A great many "General-Adjutants," unattached Generals, and other Officers belong to the *Imperial head-quarters*. Records are kept of all correspondence submitted to the Emperor in the *military chancery* which is attached to the head-quarters.

3. The War Council, presided over by the War Minister, superintends the

[1] Finland voted an army of 100,000 men; and eight "Governments" have constructed barracks, each for one battalion. In 1884 the Russian troops are to give over charge to the Finns, except at Helsingfors and Sweaborg. The Officers will be inns, but the word of command will be given in Russian.

purchase and safe keeping of stores, decides upon all contracts, and supervises the military budget. There are eighteen members of this council, who are all nominated by the Emperor. These members form five committees :—A, for codifying the rules and regulations of the service ; B, for training and organization ; C, for military education ; D, for hospitals ; E, for prisons.

4. The High Court of Appeal in military cases, which is composed of a president (a general of the highest rank) and a number of members chosen by the Emperor.

5. The Head-quarter Staff, under a chief with two assistants who exercise a general superintendence over the performance of military duties, over the general staff, and the topographical corps. The work is divided into seven great sections :—A. Quarters and movements of troops. B. Organization. C. Promotion and retirement of Officers. D. Pay, allowances, and pensions. E. Recruiting. F. Mobilization. G. Supply. The following offices are also under the head-quarter staff :—the Staff Paymaster's Office ; the Office for Asiatic Affairs ; the Judicial Council ; the Stationery Office ; the Records ; the Topographical Department ; the Military Scientific Department ; the Department for Rail and Water Transport. All Officers in disponibility (unattached) are available for duty with the depôts, and are immediately under the chief of the head-quarter staff.

6. The Commissariat Department, under the Commissary-General, with seven sections, has the general supervision over the clothing supply and provisioning of the troops. Attached to it is a technical committee for testing the quality and collecting samples of goods ; also a record office, a statistical section, and a museum for models.

7. The Department of Artillery, under a General Field Marshal, is charged with the general administration of the artillery, and with the armament of the whole army. There are seven sections and a special artillery committee. The Michael's Artillery War School for Cadets and the Artillery Academy, now united with the Engineer Academy, are under this department.

8. The Engineer Department, under an Inspector-General, has four sections, besides the engineer committee. The Nicolas Engineer Academy, for the higher instruction of Officers of this arm, and the Nicolas Engineer War School are under this department.

9. The Army Medical Department, with an Inspector-General at its head, conducts all the medical personnel, and generally superintends all matters relating to the health of the troops. There are in this department four sections, a record office, and a medical scientific committee. The Imperial Medico-Surgical Academy at St. Petersburg is under this department.

10. The Military Education Department, under a Director-General, with assistants who superintend all military educational eetablishments, those for the special arms excepted. It comprises three sections, a record office and a consultative committee of professors and schoolmasters.

11. The Cossack Department, under a chief, assisted by a deputy, controls all matters relating to the Cossack troops. There are four sections and a Cossack Committee.

12. The Judge-Advocate General's Department, with four sections, has the control of the administration of military law and the superintendence of the Academy of Military Law.

The Inspector-General of Cavalry, with his staff and officers, and the Inspector of Musketry are also attached to the War Ministry.

Army Administration in Peace and War.

The Russian Empire is divided into fourteen general governments (including the "Province of the Cossacks"), each of which is a military district. The "General Governor" is not only the principal civil official, but also commands all the troops in his district. Under him is the *District Military Council*, which is a sort of district War Office, and serves as channel of communication

between the General Governor and all the troops, field, reserve, and local, under his command. The General Governor is president of the Council, the members being the chiefs of the six departments of the district staff, the General Governor's assistant, if there be one, and a member nominated by the War Minister. Questions are decided by a majority of votes; but the president may act on his own responsibility, if he thinks fit, pending instructions from head-quarters. The Council deals with matters of finance, and the president has power to conclude contracts under certain restrictions.

Army Corps.

Up to 1876 the largest tactical unit in the field Army was the Division, to which belonged four infantry regiments, each of three or four battalions, and a brigade of artillery. The Cavalry was in like manner formed in Divisions and was only combined with Infantry in war time—a rule which applied also to the Engineers. Divisional Commanders were responsible to general governors for the tactical instruction of their Divisions. Since 1876 groups of two or more Infantry divisions, together with the Artillery brigades attached to them, and with a Cavalry Division, have been united into Army Corps. This system, which prevailed throughout the Russo-Turkish war, was made applicable in peace time also to the whole Army, except to the Finland Division and to three of the Caucasus Divisions.

There are now, in all, nineteen Army Corps, of which seventeen in European Russia and two in the Caucasus.

An Army Corps, as a general rule, includes only two Divisions of Infantry and one of Cavalry. Five Army Corps, however, have three Divisions of Infantry, and one Army Corps has two Divisions of Cavalry, whilst two Army Corps have no Cavalry.

The normal strength and composition of an Army Corps on the war footing are as follows:—

	Combatants.	Non-Combatants.	Total Men.	Horses.	Guns.
Staff of an Army Corps	16	35	51		
„ Two Infantry Divisions	10	24	34		
„ Four Infantry Brigades	4	—	4		
„ Two Field Artillery Brigades	6	44	50		
„ One Cavalry Division	4	11	15		
„ Two Cavalry Brigades	2	—	2		
Two Infantry Divisions	31,568	936	32,504	1,488	
Two Field Artillery Brigades	2,904	288	3,192	3,192	96
One Cavalry Division[1]	2,976	364	3,340	2,824	
Two Horse Artillery Batteries	370	52	422	460	12
One Rifle Battalion	981	44	1,025	61	
Engineers	1,871	337	2,208	1,233	
Two Divisions Flying Artillery Trains	1,424	196	1,620	1,828	700 vehicles.
One Cavalry Flying Artillery Park Section	142	19	161	177	
½ Rifle Flying Artillery Park Section	25	5	30	32	
Two Divisional Ambulances	—	446	446	460	
Total	42,303	2,791	45,094	10,755	108

[1] 700 vehicles, besides those of the batteries.

When the contemplated increase to Cavalry and Horse Artillery has been fully carried out, the strength of the Cavalry Division will presumably be about as

This Table has been extracted from "Armed Strength," and slightly altered, in consequence of changes made since that book was published.

The Commanders of Army Corps are under the General Governors, like the Divisional Commanders of old, but have rather more power than the latter used to have; they have not, however, in peace time, anything like the importance and authority possessed by German Officers in a similar position; a certain individuality, however, begins to show itself in particular corps, arising probably more from the personal influence of the Commander than from any other cause. The late General Skobeleff's Army Corps was a remarkable instance of this. The local troops, including hospital and recruiting departments, were formerly under a special chief, who was responsible to the General Governor. Under this chief, again, were various military officials and a mixed commission of military and civilians which managed the details of recruiting and mobilization. The reorganization of 1881 abolished almost all the local military Officers, and divided the whole empire *for recruiting purposes* into twenty-two local brigade districts of unequal size, each under command of a Brigadier having the powers of an independent Divisional General over the local reserves and depôts. The subordinate Officer next in rank to the local Brigadier is the Military Commander of the district. The new organization does away altogether with one grade in the old military hierarchy—that of Chief of the local troops of the district, and, moreover, reduces the number of local Commanders by more than two-thirds, substituting, as it does, twenty-two local Brigadiers for sixty-nine district Chiefs.

In the Don Cossack province the old system is still in force. In Finland the duties of the local Brigadier are performed by the district Chief of the Staff, and on that Officer or on his assistant devolves the duty of inspecting the military hospitals in all the districts.

Command in the Field.

When war breaks out, an army is formed of two or more Army Corps. The Commander-in-Chief only exercises supreme authority in the military districts where the Army is operating by special decree of the Emperor, failing which the several General Governors retain their power. The prerogatives of the Commander-in-Chief are strictly defined. Through his staff he controls all the arrangements made by the military officials of the districts for the subsistence of his army. If it penetrates into the enemy's country, he exercises the chief authority, civil and military, in the occupied territory. He has on his staff, in addition to the usual military officers, a field "ataman" of Cossacks to command all (so-called) irregulars not attached to any division; one of the principal officers of the Judge-Advocate's department for legal questions; an official from the Foreign Office for diplomatic business; a commissary to administer the occupied territory; a number of officers of various ranks for special duties; and, if in the country of an ally, a commissioner to represent it. The head-quarter staff of the Army is organized in the same manner as those of the War Office and of the different military districts; that is to say, it is composed of a "Field Staff" for purely military operations, which consists of a Chief of the Staff, who is second in command, with his usual subordinate departments, of a "Field Commissariat," and of a "Staff for the line of Communication." The Chief of the Staff has control over the military police, the medical department, including hospitals and auxiliary ambulances, the field post, the chaplain's department, the park of the Army (under immediate command of the Officer commanding the Artillery), the commissariat

follows:—Combatants, 4,400; non-combatants, 400: total men, 4,800; horses, 4,200; whilst there will be three Horse Artillery batteries with a total strength of—combatants, 555; non-combatants, 78: total men, 633; horses, 690; guns, 18. The strength of the Army Corps will then be about—combatants, 43,912; non-combatants, 2,853: total men, 46,765; horses, 12,361; guns, 18.

train (under the Commissary-General), the heads of the different branches of the service of communication—that is to say, of the system of stations along the lines of communication (*étappen*), of railway management (including command of the railway battalions and sections of workmen), and of post and telegraph offices. To all these departments belong a great number of officers and officials of every grade, including many attached "for particular service." The staff of army corps, Divisions, or smaller bodies, temporarily or permanently detached from the main army are similar, in due proportion to strength and the requirements of the moment, to the head-quarter staff of the Army.

Staff Establishments of an Army in the Field.

Head-quarter Staff.

Commander-in-Chief.

Officers attached to his person, besides those already mentioned.

Aides-de-camp.		Special Officers.	
Field Officers	3	Generals	2
Other Officers	3	Field Officers	2
		Other Officers	2

I.—*Staff of the Army.*

Chief of the Staff 1

Aides-de-camp .... (one of whom a Field Officer)	2	Assistant [2]	1
Sub-Chief of Staff	2	Chief of Topographical Section (Major-Gen. or Colonel)	1
Field Officers in Charge of Sections	4	Assistant	1
Assistants [1]	4	Officers in Topographical Dept.	5
Military Officials (senior)	4	Attached for Duty [1] .... (one of whom a General and two Field Officers)	6
„ „ (junior)	4	Officials in Accountant's Office	10
Chief of Office { Colonel or Maj.-General	1	Clerks	36
Assistant	1	Officials in Topographical Dept.	12
Field Officer in charge of Guides	1	Officials in Printing Office, &c.	22

Establishments subject to the Chief of the Staff.

Commandant at Head-quarters Office.

Officers, 4 (of whom 1 Major-General and 2 Field Officers); Officials, 8.

Inspector of Hospitals' Department.

Officials 10

Field Sanitary Service.

Medical Officers, 13 (including one V. S.); Officials, 14

Medical Reserve.

Medical Officers, 131 (including ten V. S.); Officials, 55

Field Post.

Officials 16

Chaplain-General's Department.

Clergymen .... 2 | Officials 5

[1] Half of these Officers belong to the Staff Corps.
[2] Belonging to the Staff Corps.

II.—*Commissariat.*

Officers	3	Officials	105

III.—*Artillery Department.*

Commanding Officer of Artillery (General or Lieut.-General)	1
Attached Officers (of whom 1 Major-General and 1 Field Officer)	5
Assistant to Commanding Officer (Lieut.-General or Major-General)	1
Senior Aides-de-camp (Field Officers)	2
Officials	16

IV.—*Engineer Department.*

Commanding Officer of Engineers (General or Lieut.-Gen.)	1
Attached Officers (of whom 1 Field Officer)	4
Assistant to Commanding Officer (Lieut.-General or Major-General)	1
Senior Aides-de-camp (Field Officers)	2
Assistants	5
Officials, &c.	10
Drivers	4

V.—*Service of Communications.*

Director-in-Chief (General or Lieutenant-General)	1
Attached Officers .... { 1 Major-General, 1 Field Officer, 2 other Officers }	4

Branches of the Service of Communications.

A. Stations—1 Chief (Lieut.-General or Major-General) ; 2 Heads of Sections ; 29 Officials.

B. Communications—1 Chief (Lieut.-General or Major-General) ; 2 Heads of Sections ; 20 Officials.

C. Post and Telegraphs—1 Chief (Lieut.-General or Major-General) ; 2 Heads of Sections ; 22 Officials.

D. Office—1 Chief (Colonel) ; 2 Heads of Sections ; 18 Officials.

VI.—*Field Ataman's Department.*

Field Ataman (Lieut.-General)	1
Field Officer Attached	1
Senior Aide-de-camp	1
Clerks....	4

Personal Escort.

Captain Commanding	1	Dresser	1
Subaltern	1	Farrier Sergeant	
Sergeant-Major	1	Artificers	
Quartermaster Sergeant	1	Train—	
Non-commissioned Officers	7	Non-commissioned Officers	2
Lance-corporals	10	Privates	48
Privates	40		
Combatants	61	Non-combatants	55

Staff of an Army Corps.

Army-Corps Commander (General or Lieut.-General), 1.

Chief of the Staff (Major-General or Colonel)	1	Officer Commanding Corps-Artillery	1
Senior Aides-de-camp	2	Commandant at Head-quarters[1]	1
Field Officer Attached	1	Officer in charge of Train[1]	1
Aides-de-camp to Corps Commander	2	Staff Surgeon	1
Other Officers (attached)	2	Chief Commissary of Corps	1
Commanding Officer of Corps-Engineers	1	Officials, &c.	10
Assistant-Engineer (2 if there are three Divisions)	1	Train[1]—	
		Non-commissioned Officer	1
		Privates	3

Staff of the Officer Commanding Corps-Artillery.

Lieut.-General Commanding	1
Aides-de-camp	2
Assistant to Senior A.D.C.	1
Clerks	4
Driver	1

Commissariat Establishment.

Officials, Clerks, &c.	13
Driver	1

Staff of a Division.

Lieutenant-General Commanding, 1.

Chief of the Staff (Colonel or Lieutenant-Colonel	1	Divisional Surgeon	1
Aides-de-camp	2	Staff Bugler[3]	1
Divisional Engineer Officer[2]	1	Clerks	8
		Drivers[4]	3

Staff of a Brigade.

Major-General Commanding, 1.

Aide-de-camp	1	Only with Rifles.
Clerks	5	Not with Line Infantry
Driver	1	or Cavalry.

Staff of a Brigade of Field Artillery.

Major-General Commanding, 1.

Aide-de-camp	1	Clerks	6
Treasurer and Quartermaster	1	Dressers	7
Surgeon and Assistant	2	Overseer of Sick	1
Veterinary Surgeon	1	Armourer	1
Riding-Master	1	Drivers[5]	2
Staff Trumpeter	1		

[1] Only in war.

[2] Only when the Division is independent. No Divisional Engineer with Cavalry Division.

[3] No staff bugler with Cavalry Division.

[4] 1 driver only in peace with Infantry or Cavalry Division; 4 drivers in war, with litter.

[5] Only one in time of peace.

The Land Forces of Russia.

The Land Forces of Russia consist of—

I.—The regular troops, which comprise—
1. The Field or Standing Army.
2. The Reserve.
3. The Depôts.
4. Fortress and Local Troops.
5. Special Corps.

II.—The irregular troops, comprising—
1. The Cossacks.[1]
2. Militia of the Caucasus.

III.—The Opoltchenié, which is composed of all men capable of bearing arms, between the ages of 20 and 40, who do not belong either to the regular or to the irregular troops.

The Field or Standing Army is divided into *Guards*, *Grenadiers*, and *Line*, each comprising Infantry, Cavalry, Artillery, and Engineers.

The different arms are distributed as follows:—

Infantry.

	Regiments.		Battalions.
Body Guard	10	=	40
Grenadiers of the Guard	2	=	8
Grenadiers	12	=	48
Grenadiers of the Caucasus	4	=	16
Line	164	=	656
Rifles of the Guard	—	—	4
Rifles of the Line (including 8 Finland Battalions and 6 Transcaspian Battalions, also 12 Battalions in Caucasus, Turkestan, and Siberia)	—	—	46
Frontier Infantry (Caucasus; Siberia, E.; Siberia, W.; Turkestan)	—	—	36
Total Infantry	192	=	854

Cavalry.

	Regiments.		Service Squadrons.
Cuirassiers of the Guard	4	=	16
Mounted Grenadiers of the Guard....	1	=	4
Dragoons of the Guard	1	=	4
Lancers of the Guard	2	=	8
Hussars of the Guard	2	=	8
Dragoons of the Line[2] (including 4 Regiments in the Caucasus)	46	=	184
Total	56	=	224[3]

[1] There are now a good many Cossack regiments on the establishment of the regular army; so that the designation "irregular" is no longer universally applicable to Cossack troops.

[2] Until very lately, the Cavalry of the Line consisted of 18 Regiments of Dragoons, 14 of Lancers, and 14 of Hussars; but by an Imperial decree, dated August 30th, 18 2, the Lancers and Hussars of the Line were transformed into Dragoons; the only representatives of the two former descriptions of Cavalry, as well as of the Cuirassiers, being now found in the Guard.

[3] With the new organization, when completed, there will be six service squadrons to each regiment, or 336 service squadrons in all.

Cossack Cavalry.

	Regiments.		Squadrons.
Cossacks of the Guard .... (4 Squadrons of each Regiment are on furlough in peace time, leaving 2 Squadrons per Regiment, which are formed into one Regiment.)	2	=	12
Ural Cossacks	—	—	1
Don Cossacks	20	=	120
Kuban Cossacks	7	=	42
Terek Cossacks	2	=	8
Total Cossack Cavalry	31	=	183
Grand total Cavalry	87	=	407[1]

Artillery.

	Batteries.			Number of Guns.
	Heavy, 4·2 in.	Light, 2·42 in.	Mountain, 2·5 in.	
Field Artillery of the Guard	9	9	—	144
„ „ Grenadiers....	11	13	—	192
„ „ Line	119	122	15	2,048
Horse Artillery of the Guard[2]	—	5	—	30
Cossack „ „	—	1	—	6
Horse Artillery of the Line[2]	—	21	—	126
Cossack „ „	—	12	—	72
Turkestan Battery	—	—	1	8
W. Siberia „	—	—	1	8
Total Field, Horse, and Mountain Artillery	139	183	17	2,634

Engineers.

	Battalions.		Companies.
Sappers of the Guard	1	=	4
Grenadier Sappers	1	=	4
Sappers of the Line	13	=	52
Turkestan Sappers	½	=	2
East Siberian Sappers	—	—	1
Railway Battalions	4	=	16
Pontoniers (Half-Battalions)	8	=	16
Torpedo Companies	—	—	4
Total Engineers	23½		99

Grand Total of the Field Army.

Infantry, Battalions	....	852	
Cavalry, Regiments	....	87	
Artillery, Batteries	....	339;	Guns 2,634[2]
Engineers, Companies	....	99	

[1] The grand total of service squadrons, when the new formations are complete, will be 519.

[2] When the new batteries are completed, there will be probably 42 guns of the Horse Artillery of the Guard and 180 guns of the Horse Artillery of the Line; and the total number of guns in the Field Army will be 2,700.

The Different Arms.

Infantry.

The twelve regiments of the Guard are distinguished by titles and honorary designations. Grenadier regiments are numbered from 1 to 16; and line regiments from 1 to 164. Each regiment has, besides its number, a local title, taken from the town which is usually its head-quarter station in time of peace; and many regiments also bear honorary designations.

The four rifle battalions of the Guard have the following titles:—1. The Emperor's. 2. Tsarskoe Selo. 3. Finland. 4. The Imperial Family's.

The twenty European rifle battalions of the line are numbered consecutively; so also are those of Finland, and those of the Caucasus and of the different Asiatic districts, each independently.

The frontier battalions are divided into four groups (Caucasus, Turkestan, East Siberia, West Siberia), in each of which there is a separate numbering.

Tactical and Administrative Organization.

The *Company* is the smallest tactical and administrative unit. Its establishment is now the same in all Infantry battalions, whether of the Guard, Grenadiers, Line, or Rifles; namely, *in peace-time*—

Officers: Captain, 1; Lieutenant, 1; Sub-Lieutenant, 1	3
Non-commissioned Officers: Sergeant-major, 1; Quartermaster-sergeant, 1; Sergeants, 4; Corporal, 1	7 [1]
Volunteers (candidates for commissions)	2 [2]
Drummers	2 [3]
Privates (with arms), of whom 10 Lance-corporals	96
Ditto (without arms)	4 [4]
Total, all ranks	114

In war-time—

Officers: Captain, 1; Lieutenant, 1; Sub-lieutenant, 1; Ensign, 1	4
Non-commissioned Officers: Sergeant-major, 1; Quartermaster-sergeant, 1; Sergeants, 4; Corporals, 14	20
Volunteers	2 [2]
Drummers	2 [3]
Hospital orderly	1
Privates (with arms), of whom 20 Lance-corporals	200
Ditto (without arms)	15 [5]
Total, all ranks	244

[1] Reduced from 10 by Imperial order of 12th September, 1881.

[2] Reduced from 4 by same order. Two additional volunteers, however, may be borne on the strength, serving at their own expense.

[3] The buglers formerly on the strength of companies in Grenadier regiments were reduced by the same order. Men are now taken from the ranks to act as buglers, two per company, one of whom also acts as marker. The regiments of the Guard and the Rifle battalions still have two buglers per company on their strength. "Battalion" drummers and buglers were struck off.

[4] These men are employed as Officers' servants.

[5] Employed as cooks, orderlies, and Officers' servants.

The Company is divided into four *divisions*,[1] each of which is under a first-class Non-commissioned Officer for purposes of interior economy. Each division is subdivided into two *sections* ("Otdjalenie") in peace time; into four *sections* in war time. These sections are under second-class Non-commissioned Officers for interior economy; or rather at the present time, owing to the great reduction in the establishment of Non-commissioned Officers, under Acting or Lance-corporals. Each subaltern Officer superintends two divisions for interior economy, and commands a division in the field. The ensign (answering to the German Portepéefähndrich) does duty as an Officer. Four companies form a battalion. The battalion commander (a Lieutenant-Colonel or Major) and the captains of companies occupy the same relative position as in the German army; that is to say, the former exercises only a general supervision and control over the latter, who are directly responsible to him for the training, discipline, and general condition of their men. The commander of an independent battalion has the powers of a regimental commander.

Establishment of a Battalion of Infantry.

Combatants.

Officers.	Peace.	War.
Battalion Commander—Lieut.-Colonel or Major	1	1
Company Commanders—Captains half, 2nd Captains half	4	4
Adjutant	1	1
Subalterns—Lieutenants, Sub-Lieutenants, and Ensigns	8	12
Total Officers	14	18
Non-commissioned Officers and Privates—Company Sergeant-Majors	4	4
Company Quartermaster-Sergeants	4	4
Non-commissioned Officers—1st Class, Sergeants	16	16
" " 2nd Class, Corporals	4	56
Drummers	8	8
Lance-corporals	40	80
Privates	360	780
Volunteers	8	8
Total Non-commissioned Officers and Privates	444	948
Total Combatants	458	966

Non-Combatants.

Classed as Officers.	Peace.	War.
Surgeons, 2nd Class	1	1
Total classed as Officers	1	1

[1] This word being used in two senses, first to denote a body composed of several regiments of cavalry or infantry, secondly (as in the present case, a certain portion of a company, of a squadron, or of a battery, in order to distinguish between the two meanings, a capital *D* will be prefixed in the first case, and a small *d* in the second case, throughout this paper.

Classed as Officers.	Peace.	War.
Other ranks—Clerks, 1st Class	1	1
„ 2nd Class....	1	1
Hospital Assistants, 2nd class	1	1
„ „ Company	4[1]	0
Dressers	4	4
Drivers	3	12
Total Non-combatants	15	20
Add total Combatants	458	966
Grand total per battalion	473	986

Horses.

Chargers—Commanding Officer	1	1
Adjutant	1	1
Captains	0	4
Draught	6	42
Total horses	8	48

N.B.—The establishment of the Guard and Grenadier regiments differs slightly from that of the Line regiments in the number of musicians and of non-combatants, but the difference is hardly worth recording.

Establishment of a Rifle Battalion.

Combatants.

Officers :	Peace.	War.
Battalion Commander—Colonel, Lieut.-Col., or Major	1	1
Second Field Officer—Major	1	1
Company Commanders—1st Captains	2	2
„ „ 2nd Captains	2	2
Adjutant	1	1
Paymaster and Quartermaster	1	1
Arms—Officer	1	1
Subalterns	8	12
Total Officers	17	21
Non-Commissioned Officers and Privates :		
Sergeant-Majors (Company)	4	4
Quartermaster-Sergeants (Company and Battalion)	6	6
Sergeants	16	17
Corporals	4	56
Drummers or Buglers (Battalion)	1	1
„ „ (Company)	8	8
Lance-corporals	40	80
Privates	360	780
Volunteers	8	8
Total Non-commissioned Officers and Privates	447	960
Total Combatants	464	981

[1] Attached to the hospitals in war-time.

Non-Combatants.

Classed as Officers :	Peace.	War.
Surgeons (1st Class)	1	1
„ (2nd Class)	1	1
Accountant	1	1
Total classed as Officers	3	3
Other ranks :		
Clerks — Battalion	1	1
Clerks — 1st Class	2	2
Clerks — 2nd Class	2	2
Dressers — 1st Class	1	1
Dressers — 2nd Class	1	1
Dressers — Company	4	4
Dressers — Veterinary	4	1
Acting Dressers[1]	4	0
Inspector of Sick	1	1
Hospital Orderlies	2	2
Master Armourer	1	1
Cutter and Fitter	1	1
Tradesmen	6	8
Drivers[2]	4	16
Total other ranks	30	41
Total Non-combatants	33	44
Add total Combatants	464	981
Grand Total	497	1,025

Horses.

	Peace.	War.
Chargers	1	1
Baggage	8	60
Total	9	61

Four battalions form a regiment under a Colonel (in the Guard, a Major-General).

ESTABLISHMENT OF A REGIMENT.

Combatants.

Officers :	Peace.	War.
Regimental Commander	1	1
Battalion Commanders	4	4
Extra Field Officers (Majors)	2	2
Captains commanding Companies	8	8
Second Captains commanding Companies	9	9
Regimental Adjutant[3] — Lieutenants	7	7
Treasurer and Quartermaster — Lieutenants		
Officer in charge of the Arms — Lieutenants		
Four Battalion Adjutants — Lieutenants		
Subalterns	32	48
Total Officers	63	79

[1] Attached to hospitals in war.

[2] In the Frontier Battalions there are 13 drivers in peace time, and 44 in war time.

[3] A Captain (2nd Class).

Non-commissioned Officers and Privates :	Peace.	War.
Sergeant-Majors { 1 Regimental / 16 Company }	17	17
Quartermaster-Sergeants .... (3 in Regimental and 16 in Company employ)	19	19
Non-commissioned Officers { Sergeants,[1] 1st Class	65	65
Non-commissioned Officers { Corporals,[2] 2nd Class	16	225
Musicians { ranking as Non-commissioned Officers } 1st Class, Sergts.	1	1
Musicians { ranking as Non-commissioned Officers } 2nd Class, Corporals	10	10
Musicians { Privates	24	24
Drummers, Regimental	1	1
,, Company	32	32
Bugler, Regimental	1	1
Lance-corporals	160	320
Privates	1,440	3,120
Volunteers	32	32
Total Non-commissioned Officers and Privates	1,818	3,867
Total Combatants	1,881	3,946

Non-Combatants.

Classed as officers :		
Surgeons, 1st class	1	1
,, 2nd class	4	4
Paymaster	1	1
Chaplain	1	1
Total	7	7
Other ranks :		
Clerks { Regimental	1	1
Clerks { 1st class	4	4
Clerks { 2nd class	5	5
Hospital Assistants { 1st class	1	1
Hospital Assistants { 2nd class	4	4
Hospital Assistants { Apothecary	1	1
Hospital Assistants { Company	16	16
Hospital Assistants { Veterinary Surgeon	1	1
Dressers[3]	16	0
Superintending the Sick	1	1
Hospital Orderlies[4]	3	0
Sacristan	1	1
Master Armourer	1	1
Master Tailor	1	1
Tradesmen[5]	10	18
Drivers[6]	12	48
Total Non-Combatants	86	117
Total Combatants	1,881	3,946
Grand Total	1,967	4,063

[1] One of them has charge of the transport.
[2] One of them attached to the transport in war.
Attached to the hospitals in war.
[4] Increased to 10 in peace time, when the regimental hospitals are open.
[5] The proportion of the different kinds of tradesmen is fixed by the Colonel.
[6] The regiments of the Caucasus have 65 drivers in war time, and 249 draught horses.

Horses.

Draught[1]	24	201
Chargers (including one for Regimental Bugler)	13	31
Total Horses	37	232

Of the two extra Majors who form part of the regimental staff, one assists the Commanding Officer in his general duties, whilst the other is at the head of the regimental workshops and has charge of the funds. Besides the Officers mentioned in the regimental establishment as forming part of the regimental staff, there are several subalterns attached to it who are nevertheless on the strength of companies—

1. An Officer to visit the regimental hospital.
2. One charged with the supervision of the regimental school.
3. A commandant of the non-combatants (tradesmen and drivers).
4. A regimental marker.
5. A court-martial secretary.

The regimental adjutant has charge of the band.

The following table shows the difference between the present and former (previous to 1881) strength of an infantry regiment :—

	Officers.	Volunteers.	N.-C. Officers.	Drummers, &c.	Privates.	Total combatants (including Officers' servants).
Present war footing	79	32	326	32	3440	3911+in addition 35–55 musicians.
Former	80	64	320	38	3600	4102
Present peace footing	63	32	117	34	1600	1846+in addition 35–55 musicians
Former	64	64	160	38	1600	1926

Two regiments (eight battalions) form a Brigade under the senior regimental commander, who has no permanent staff nor office allotted to him. An Officer detached from one of the regiments does the office work of the brigade in one of the regimental orderly rooms. Organization by brigades is a novelty in the Russian service, and in peace time is almost a dead letter except for field exercise.

Two brigades, with the addition of an artillery brigade, form a *Division*, which even now, since the introduction of the *army-corps* organization, is considered by the Russians to be the handiest of the larger units ; and, in truth, an infantry Division of sixteen battalions (12,000–16,000 combatants), with in addition one or two battalions of *Rifles*, its quota of forty-eight guns, one or two companies of engineers, and a due proportion of cavalry, is quite capable of carrying out an independent operation on a considerable scale. Smaller detachments are formed of an infantry brigade with one or two batteries and one or two squadrons.

Infantry Tactics.

After a long and warm controversy between the two schools of tactics, namely, that which adhered to the old bayonet tactics naturalized by Suwarow, and that which especially favours fire tactics, the latter school gained the

[1] The regiments of the Caucasus have 65 drivers in war time, and 249 draught horses.

ascendency, and, in Russia as elsewhere, it was recognized that infantry fire had become the most important factor in modern warfare, offensive as well as defensive. The bayonet school, however, was not thoroughly put out of court till after the war of 1877-78, a mass of evidence being then produced which could not fail to convince even the most obstinate defenders of the old system. Even before the war, indeed, the new idea had spread so far as to lead to the appointment of a Commission which drew up some new "rules for training the company and the battalion for war," and the army was called upon to try the innovations therein recommended. After the war these experiments were continued with the advantage of the light thrown upon them by the experience gained in Turkey, resulting in a new edition of the Field Exercise Book, in four parts, which was commenced in the winter of 1879–80, and completed in March, 1881. This work, with a supplement on the conduct of troops in battle, is now the text-book for the Russian infantry. We will notice its most remarkable points.

1. The training of soldiers, both individually and collectively, as skirmishers is recognized as the most important part of infantry instruction.

2. With a view to better fire-discipline, a distinction is made between "slow" and "rapid" fire which did not previously exist. The Officer points out the object to be aimed at, and names the distance. The practice of ordering a certain number of rounds to be fired is introduced, as is also that of volley-firing with the use of various sights at the same time.

3. When a section extends, the distance between men is not to exceed two paces. The smallest link in the chain is now the non-commissioned officer's party of six files. No interval is, as a general rule, kept between these links.

Theoretically, skirmishers are kept under control even more than men in close order, no individual initiative being allowed. Units, from the smallest upwards, may be intermingled without regard to their proper position in the battalion; but each unit must be kept intact. Bugle sounds are reduced to a minimum. The whistle is used to call attention. Skirmishers rally on their own company reserve, and every company covers its own front. Battalions in the first line are usually formed for battle in two lines, each composed of two companies in line of company columns with small intervals. Each company in the front line then throws out skirmishers, and forms its own reserve; the two companies in the second line forming the battalion reserve.

The amount of interval between skirmishers depends upon circumstances, but, as a general rule, a company extended is supposed to occupy a front of 250 paces; that is to say, 500 paces are allowed for the front of a battalion, or 1·16 pace per man. It rests, according to regulation, with the commander of the battalion to determine how many divisions per company are to be extended when skirmishers first move out at the beginning of an attack on an enemy in position; and it is usual for each of the divisions told off for this purpose to send a small patrol 300 paces in advance, to cover its front, when the enemy is still some 2,000 paces distant, so as to postpone its complete extension as long as possible. In wood-fighting, companies keep up their communication with one another by means of similar patrols. The chain of skirmishers pushed forward by the companies in first line should be reinforced to the full strength desired when 800 paces from the enemy, the company reserves keeping, when on open ground, 500 paces behind them; the battalion reserves are 500 paces further to the rear. The formation of these reserves will depend upon the nature of the ground, and the amount of fire brought to bear upon them. If the ground be open, and the fire heavy, line formation with open files will be adopted. The advance will be as uninterrupted as possible, the skirmishers, however, halting, when advisable, to fire. The expenditure of ammunition should be carefully watched, so as to reserve as much as possible for close quarters. Seven rounds in two minutes

should never be exceeded at this stage of the combat, which is called the *zone of advance*.

At 800 paces from the enemy, the assailants are supposed to enter the *zone of attack*, which extends to within from 300 to 150 paces from the enemy, or, it may be said, to the most advanced point at which it may be possible to gather for the final rush. During this, the second stage of the affair, the skirmishers advance by rushes of alternate divisions, the company reserves gradually closing up, so as to join them when they come to their last halt, remaining themselves, however, in compact formation, the battalion reserves closing gradually upon the fighting line, which increases its fire to the utmost. Now comes the final stage of the affair, called the *bayonet charge*. The skirmishers, followed closely by the company reserves, advance on the enemy with drums beating. At about 50 paces from the position the word is given to cheer and charge. On gaining the position, the reserves, if still in hand, fire volleys on the retreating enemy, who, as a general rule, must on no account be pursued except by fresh troops, if any should happen to be available, or by those which have just attacked, only after they have been rallied and re-formed.

In treating of a defensive action, great stress is laid upon proper occupation and entrenchment of the position; upon securing the flanks; upon measuring the distances of surrounding objects; upon making a vigorous sally at the right moment, if possible from a flank of the position.

Bodies of troops engaged with the enemy are not to expect relief, but must hold their ground to the last.

The arrangements for keeping up the supply of ammunition are as follows. There are 16 ammunition wagons allotted to each infantry regiment, and 4 to each rifle battalion. At the commencement of an action, one wagon moves up to the rear of each infantry battalion, and two wagons to the rear of each rifle battalion engaged, each wagon under charge of a non-commissioned officer. On open ground they remain about 1,000 paces behind the fighting line; if there is good cover, they take advantage, and push forward as far as can be done with security. Two men are told off in each company of the fighting line, for the purpose of bringing up ammunition from the wagons when ordered to do so. At critical moments, wagons may even drive right up to the combatants.

Ammunition wagons carry white flags by day and green lights by night.

The retreat of a body of infantry in close proximity to the enemy is carried on, if not hardly pressed, in the same manner as the second stage of the advance, by alternate rushes, covered by the fire of the halted parties; but if the enemy pursues vigorously, no fixed rules are given, except that all commanding positions on the line of retreat must be occupied, and that sudden offensive returns should be made to check the enemy. Cavalry attacks may be received in any formation whatever. The chain of skirmishers and the reserves only draw towards one another for mutual support if the ground is open, and if there is plenty of time to make the movement without undue hurry. The skirmishers then form groups, and the reserves are placed in échelon to these groups. If the reserve is in column, the front divisions deliver their fire from the knee. In order to accustom foot-soldiers to horsemen, and *vice versâ*, cavalry are made to charge through partially extended infantry; and in the absence of cavalry, parties of mounted Officers, of whom there are from 8 to 12 in each infantry regiment, are used for this practice.

Infantry and artillery are worked together a great deal, and the former are taught that, when guns are lost, the disgrace of the loss falls upon the body of infantry which was nearest to them, and which should take as great care of them as if specially detached to escort them. If guns are occupying commanding ground, skirmishers should always be extended in front of them, and their reserves behind or on the flank of the battery. The practice

formerly in vogue of training infantry and cavalry soldiers as gunners, so as to reinforce the latter at need, has been abandoned, partly on account of the shortened service of infantry, and partly on account of the strength of the battery establishments.

And now a few words as to drill and formation in close order, which have been much simplified.

The cadence in marching is now from 116 to 120 paces per minute, whereas formerly it was only from 112 to 116.

The touch is looser in the ranks than formerly. Whereas by the old regulations three fingers' breadth was allowed between files, a whole hand's breadth is now allowed, and the rear rank is now supposed to be the length of a man's arm from the front rank. The position of the soldier is easier and less constrained. The manual exercise has been simplified. Double columns are done away with. Open column and line formation of the battalion are only retained for parade purposes. Squares to resist cavalry are no longer used, as it is held that infantry should hold their own in any formation against horsemen. Company drill is simplified. Battalions are now formed either in close column of companies, half companies, sections and half sections, in column by companies (*i.e.*, mass of company columns), or in line of company columns (a very handy preparatory and manœuvring formation). In changes of front companies move independently, and by the shortest line, to their new ground. In brigade movements the usual formation of a battalion is the close column of half companies. There are no drill regulations for a larger body of infantry than the brigade; and with regard to the latter they are limited to its formation in reserve and to its deployment into lines of battalions at full intervals, which formation immediately precedes that for attack.[1]

Arms used by Russian Infantry.

Rifle.—The Berdan (pattern 1871), a "door-bolt" breech-loading arm, is now issued to the whole of the infantry and rifle battalions of the standing Army. The local and depôt troops still retain the Krinka or the Carlé rifle, with one or other of which inferior weapons the greater part of the Russian infantry was armed during the last Turkish war.

The Berdan has a calibre of 0·420 in. and six grooves. Its weight is 9 lbs. 4 oz. without the bayonet, and 10 lbs. 3 oz. with it. Length, without bayonet, 4′ 5″, and with it 6′. The bayonet is always fixed on service, the scabbard being left at home. The bullet is of lead, hardened with tin, and weighs 371 grains. Charge of powder 79 grains. Cartridge, central fire, of solid brass and bottle-necked, weighing in all 608 grains. Initial velocity, 1,356 feet per second, with a very flat trajectory at short ranges. Sighted up to 1,250 yards, will carry up to 2,200 yards, and can fire from 12 to 15 shots per minute.

Tessak.—A short, straight two-edged sword, worn now only in time of peace by non-commissioned officers when off duty.

Sword.—Sergeant-majors wear swords like Officers.

Revolver.—Sergeant-majors, drummers and buglers carry the Smith and Wessen revolver in a leather case on the waistbelt, secured by a cord passing round the neck. This revolver has six chambers, and weighs 2 lbs. 6¾ oz. Calibre, 0·401 in. Charge of powder, 34 grains. Bullet weighs 200 grains. Cartridge, central fire and of solid brass.

[1] A British Officer, who is a competent judge, and who has had plenty of opportunities of studying the Russian Army of late, remarks that "the infantry drill is second to none; and the same may be said as to the instruction given to young Officers. In the winter, they are kept hard at theory in barracks from morning to night, and it is quite a relief to them when the climate allows them to get out of doors."

Musketry Instruction.

Before the late Turkish war the only troops who received careful instruction in rifle-shooting were the riflemen, who were armed with a superior weapon, and received 150 rounds annually for target practice. When, however, the Berdan rifle was generally introduced, light companies abolished, and all infantry placed virtually on the same footing, the old regulations for musketry instruction, dating from 1876, were replaced by a new code drawn up by a committee presided over by the Inspector-General of Musketry, which code came into force in 1879. Every infantry soldier was required to fire 150 rounds yearly. It soon, however, became apparent that the course of training required too much time to be carried out properly under the present system of short service, particularly as rifle ranges are so often deficient, both at the garrison towns and at the camps of exercise. It became, therefore, necessary to curtail the course, and a new code of instruction was issued on the 28th March, 1881, which, without departing from the general principles adopted in 1879, considerably reduced the demands upon the soldier's time. The annual course is divided into "preparatory practice," the "regular course," and "field firing:" 130 rounds in all are fired. Preparatory practice is carried on at 200 and 300 paces. Recruits also fire 8 rounds at 100 paces. Three shots in four must hit the target at each practice, before the firer is allowed to go on to the next one. The "regular course" consists of fourteen individual practices, executed in various positions and at various targets, on the different ranges between 200 and 800 paces, four rounds in each practice. After this comes rapid independent firing at 200 paces; then volley-firing, lying down, kneeling and standing at targets between 300 and 900 paces. Great importance is attached to the last-named practice, which is succeeded by "field firing," to which 32 rounds are devoted. The men are divided into three classes at the end of the "regular course," according to the marks obtained therein. "Field firing" is, as a rule, performed by companies independently, under their Captains. It is divided into two practices—individually, and from eight to twelve collectively, at unknown distances, including "indirect firing" at concealed targets.

When a body of troops is firing at long unknown ranges the rear rank men sight their rifles 100 paces under the estimated distance.

Officers have to go through the same course of target practice as the men. During the winter months much attention is paid to position and aiming drill, a chamber rifle being also used in barracks as a preparation for the regular target practice.

Although a great stimulus has been given to rifle-shooting, the results have by no means been universally satisfactory. In the course of 1881 the Inspector-General of Musketry and eight other specially selected Generals visited 340 different corps of infantry, cavalry, and engineers to ascertain how far the instructions as to preliminary drill and target practice were carried out. Their report was not, on the whole, favourable. This may be accounted for partly by the want of a sufficient number of good instructors, but principally by want of time and by the scarcity of ranges. Out of the 340 corps visited, only 124 had completed the annual course; 314 were inspected, and although the rifle battalions were alone pronounced to have made *excellent* practice, whilst the guards and grenadiers only did as a rule *fairly well*, and the performance of the line infantry was *indifferent*, yet it must be remarked that the figure of merit of even the last-named troops was 8 per cent. higher than the year before, so that there is evidently a marked improvement. The Officers' practice with rifle and revolver was on a par with that of the men of their several corps.

At field-firing the Officers led their men with intelligence and coolness, as

did also the sergeants. The corporals did less well, and the performance of the men was far from satisfactory.

The scarcity of good instructors, want of time and of ranges, have already been mentioned as impediments to good rifle practice in the Russian Army; but there is another circumstance which perhaps still more stands in the way of progress in this direction, and that is the prejudice which still exists in the Russian Army, and in high and influential quarters too (a prejudice, by the way, not altogether confined to Russia), in favour of the old bayonet tactics, combined with steady shoulder to shoulder movements, in opposition to the "new-fangled" theories about fighting in extended order and the development of rifle fire.

The Dress and Equipment of the Infantry.

Changes in dress and equipment have long been contemplated, and particularly since the last Russo-Turkish war. The present regulations upon these matters date from January and November, 1881. Considerable changes have been made, the principal of which are noted below, whilst giving a general description of dress and equipment. A double-breasted coat fastened by hook and eye, the only buttons being on the shoulder-strap, has been substituted for the old single-breasted tunic fastened by buttons. The new coat is made all in one piece, very roomy in the body and skirts, and can be drawn together so as to fit the waist by means of an inner belt. The advantages of the new costume are considerable. First of all, the absence of buttons, which are troublesome to clean, and which make the wearer unpleasantly conspicuous; secondly, the roominess of the coat, which leaves free play to the lungs and arms, and admits of extra clothing being worn underneath in cold weather; thirdly, the ease with which a coat may be made to fit almost any man merely by shifting the hooks and eyes—a great point when the reserves are called out on mobilization. As the principal of these reasons for the change does not apply to Officers, they are allowed to gratify their taste for smartness by having their coats made to draw in at the waist, but, like the men, they are deprived of their buttons. They retain their epaulets. The men have side-pockets for ammunition in their tunics. The different-coloured badges which serve to distinguish the regiments of each infantry division are sewn on the collar. Brigades are known by the colour of the shoulder-strap. Coat and trousers are of dark-green cloth; but, in summer, blouses and trousers of white linen are generally worn. Trousers are made short, and to tuck into the boots (which reach to the knee), and are always worn so on duty. A comfortable black busby, without a peak, has been substituted for the old shako. A forage cap is also carried. The waistbelt is of black leather, and the two ammunition-pouches, each containing twenty rounds, are suspended from it.

The men have double-breasted grey cloaks, with hoods; also cloth mits, neckcloths (the fashion of which has been altered by the new regulations), and cholera belts. Bandages are worn on the feet instead of socks—in summer of linen, in winter of wool.

Officers of all ranks wear short trousers, tucked into the boots, on duty, but long braided trousers when off duty.

The knapsack, which was large and heavy, has been given up, being replaced by a waterproof bag made to hang over the right shoulder, secured by a fastening round the hips, and connected with a portion of a tente d'abri, which each soldier is in future to carry. The cloak is worn "en bandoulière" over the left shoulder, with a waterproof havresack containing three days' rations. A tin bag, containing forty-four rounds of ammunition, is secured in the kit-bag. These rounds will be transferred to the coat-pockets in action. The Russian soldier carried formerly a very large service kit, weighing, with arms, ammunition, and three days' rations, over 80 pounds. Although extra

ammunition and a portion of a tente d'abri have been added to his load, the authorities aim at reducing the total to 60 pounds—a result which can only be attained by a considerable reduction in the amount of "necessaries" carried in his bag. This subject is still under consideration, and we believe that as yet no definite arrangement has been made.

Each soldier, further, carries a wooden water-bottle; and 80 short spades, with 20 axes, are distributed amongst the men of each company; in addition to which tools, 10 spades, 24 axes, 3 shovels, 3 picks, and 1 crowbar per company are conveyed in the ammunition-wagons.

Of all the infantry, the Guards alone retain the old tunic—that is to say, double-breasted, and turned back in front, with two rows of buttons stamped with the imperial eagle, yellow in the 1st and 2nd divisions, and white in the 3rd. The shoulder-straps are red, bearing an imperial crown, with other honorary marks. The new short trousers have been adopted, but with narrow red stripe. The old black helmet, with metal ornaments of the same colour as the buttons, is retained; but the new forage cap has been introduced, also the cape. In other respects the dress and equipment are the same as in the Line Infantry; and the coat now worn by the latter is so much approved of, that it is thought probable that the Guards will ere long adopt it.[1]

The Cavalry.

Regiments of the Guard are distinguished by titles and honorary designations; regiments of the Line by numbers, local titles, and, in most cases, by the names of honorary colonels.

There are to be in future six squadrons in each cavalry regiment in peace-time, with the addition of one depôt squadron in time of war. The establishment of the service squadron will be about the same in peace as in war, namely, 145 horses. The regiment will, therefore, muster 870 combatants. The augmentation is being made gradually, and is to be completed in three years.

The regular cavalry regiment, whether of the Guard or Line, has consisted hitherto of four field squadrons and one depôt squadron, with one company of non-combatants. The latter is employed in peace time to break the remount horses before they join the regiment in war time, to train both man and horse, so as to keep the field squadrons up to their strength. It has two establishments—one permanent as a cadre, the other variable according to the number of young soldiers and horses required by the regiment. The depôt squadrons of line regiments are quite independent of these, as regards administration and command, being grouped by sixes in depôt brigades, each of which feeds two Divisions, with the exception of the four depôt squadrons of the Caucasus, which form the depôt brigade of the Cavalry of the Caucasus. The depôt squadrons of the Guard, on the other hand, are not separated from their regiments in peace time, but in time of war form a depôt brigade of the strength of ten squadrons. On mobilization and during war, Officers and men of the reserve who have previously served in the Cavalry join the depôt squadrons, to be formed into provisional detachments and sent to the front as required.

The Field Regiment is composed of four squadrons, each consisting of four sections of 16 files combatants.

[1] The change has, we are informed, already been made (1883). The new uniform has not only its own intrinsic merits, but sentiment in its favour, being much of the same pattern as the dress worn by the Russian peasant.

OLD ESTABLISHMENT OF A CAVALRY REGIMENT (THE NEW ESTABLISHMENT IS NOT YET PUBLISHED).

Combatants.

Officers.	Peace.	War.
Commanding Officer[1]	1	1
Commander of Wings (two Squadrons) { Colonel	1	1
{ Lieutenant-Colonel	1	1
Commanders of Squadrons—Captains	4	4
Staff: 1. Regimental Adjutant; 2. Treasurer and Quartermaster; 3. Instructor in Arms; 4. Commander of the Non-combatant Company and in charge of the regimental Hospitals	4	4
Subalterns	20	20
Total Officers	31	31

Non-commissioned Officers and Privates.

Sergeant-Majors	4	4
„ of the Non-combatant Company	1	1
Quartermaster Sergeants	6	6
Non-commissioned Officers—1st Class, Sergeants	16	16
„ „ 2nd Class, Corporals	28	29
Regimental Trumpeter	1	1
Trumpeters....	16	16
Acting Trumpeters	4	4
Lance-Corporals	16	16
Privates	604	604
Volunteers	16	16
Total Non-commissioned Officers and Privates	712	713
Total Officers	31	31
Total Combatants	743	744
Total Non-combatants	87	91
Grand total	830	835

Non-Combatants.

Classed as Officers.	Peace.	War.
Surgeons, 1st Class	1	1
„ 2nd Class	1	1
Veterinary Surgeon	1	1
Accountant....	1	1
Riding Master[2]	1	0
Chaplain	1	1
Total classed as Officers	6	5

[1] In the Cavalry of the Guard, the regimental commissioned Officer is a Major-General; and both commanders of divisions, Colonels. One of the latter Officers manage the regimental funds and workshops.

[2] Goes to the Depôt Squadron in war time.

Other Ranks.

Classed as Officers.	Peace.	War.
Clerks, Regimental	1	1
„ 1st Class	4	4
„ 2nd Class	5	5
Hospital Attendants: 1st Class	1	1
Hospital Attendants: 2nd Class	2	2
Hospital Attendants: Squadron	4	4
Hospital Attendants: Apothecary	1	1
Hospital Attendants: V. S., 1st Class	1	1
Hospital Attendants: „ 2nd Class	4	4
Dressers	5	0
Superintendent of the Sick	1	1
Hospital Orderlies[1]	2	2
Sacristan	1	1
Armourer Sergeant	1	1
Armourer, 1st Class	1	1
„ 2nd Class	1	1
Master Farrier	1	1
Master Saddler	1	1
Tradesmen	16	16
Cutter	1	1
Fitter	1	1
Tailors and Shoemakers	20	20
Drivers[2]	6	16
Total other ranks	81	86
Classed as Officers	6	5
Total Non-combatants	87	91

Horses.

	Peace.	War.
Chargers: Officers[3]	33	74
Chargers: Men	577	577
Draught	15	51
Ridden by Non-combatants	0	4
Total Horses	625	706

The regular Cavalry is organized in two Divisions of the Guard and eighteen Divisions of the Line, the latter consisting each of four regiments, including one of Cossacks to each Division quartered in Europe (fourteen in number). The 1st Division of the Cavalry of the Guard comprises, like all the Line Divisions, two brigades; but the 2nd Division consists of three brigades, in the second of which is the squadron of the Oural Cossacks of the Guard, in addition to a regiment of Cossacks. There are three Divisions of Cavalry of the Caucasus, each formed in two brigades. In the 1st Division are three regiments of Cossacks; in the 2nd, four; and in the 3rd, three. The 18th Line Division is that of the Don Cossacks, composed of four Cossack regiments, formed in two brigades. The Cavalry Divisions of the Guard have five batteries of Horse Artillery and a Don Cossack battery, which form an independent brigade in peace time (with the exception of one battery

[1] There are eight when the regimental Hospital is open.

[2] All Cavalry, except Dragoons, have 15 per regiment. Those of the Caucasus have 27 in war, 18 in peace.

[3] Of these 9 in peace and 50 in war are the Officers' private property.

detached to Warsaw), but in war time are distributed amongst the three Divisions. Line Divisions 1 to 7, and also 13, 14, have each two batteries of Horse Artillery. Divisions 8 to 12 have each one battery of Horse Artillery and one Cossack battery, whilst Divisions 15 to 18 have each two Cossack batteries.

The Guard Divisions form part of the Guard Corps. The Don Cossack Division is attached to the Grenadier Corps. Line Divisions 1 to 14 belong to the Army Corps with similar numbers. The 15th and 16th Divisions (1st and 2nd of the Army of the Caucasus) are attached to the 1st and 2nd Army Corps of the Caucasus. The 15th Army Corps has no cavalry; whilst the 17th Cavalry Division (3rd of the Caucasus) is at present unattached. The Bashkir regiment, originally formed in 1874 and brought up to full strength in 1878, consisted of 35 Officers and 270 men, detached from the regular Army for the purpose of training the Bashkirs who served for short periods, and whose complete establishment was 604. This regiment was disbanded in July, 1882, and is to be replaced by a Militia corps. The drafts from the regular cavalry returned to their regiments, and the Bashkir soldiers were enrolled in the reserve.

The Commanders of Divisions are Lieutenant-Generals. They have the usual staff—a Colonel as Chief, two Adjutants, Surgeons, &c. As in the Infantry, this brigade command counts for little except in the field. The senior regimental Commanding Officer usually commands the brigade without the help of any regular staff.

Whilst, as we have seen, the ordinary Cavalry regiment is broken into two wings, each consisting of two squadrons, the Cossack regiment (Polk) is formed in three divisions, each likewise of two squadrons (sotnias) of about the same strength as the Line squadrons; the Cossack regiment is thus half as strong again as an ordinary Cavalry regiment.[1] But there are many peculiarities in the organization and habits of Cossack troops which will be noticed further on.

Always excepting the Cossacks, who are horsemen from their childhood, and to a less extent the inhabitants of the western and southern provinces, in which the Cavalry Divisions are mostly stationed, and where the supply of horses is comparatively large, the Russian peasant has not much opportunity of learning to ride; hence the material for Cavalry, in point of men, is not particularly good. However, the recruits apparently best fitted for this purpose are selected from the annual contingent, and the enormous supply of ready-made horsemen in the Cossack regions goes far to make up for a deficiency in this respect in other parts of the empire.

Cavalry Officers in Russia, as in some other countries, in great measure belong to the richer classes.

Arms and Equipment.

Cuirassiers (now only of the Guard).

Tunic.—For full dress, white cloth, with piping and shoulder-straps of distinctive colours; for undress and active service, dark green cloth, with similar ornaments.

Cuirass of yellow metal, weighing 17 to 20 lbs.

Overalls.—Full dress, dark blue, with dull red stripe; undress on active service, French grey pantaloons, and knee boots.

Headdress.—Helmet of yellow metal, with a double eagle on the top for state occasions; also a flat white cloth cap, without a peak, which is worn on service.

[1] The strength and organization of ordinary and Cossack cavalry regiments will apparently be the same in future.

In summer and on fatigue, white linen tunics and trousers are worn, as in the Infantry.

Cloak, the same as in the Infantry.

Leather gauntlets. Straight steel spurs.

Waistbelt, white leather, with revolver-case on the right side. Sword (of a new pattern, straighter and lighter than of old), in a wooden scabbard, covered with leather, and suspended by a white crossbelt over the right shoulder, instead of, as formerly, in a steel scabbard secured by slings to the waistbelt. A small pouch for revolver-ammunition is on the crossbelt.

Front-rank men are armed with the lance, as well as with sword and revolver. The lance is nine feet long, and weighs 6 lbs. 11 oz.[1]

The revolver is the same as that used by the Infantry and other arms, already described.

Horse appointments.—There is only one pattern of saddle for all the regular Cavalry. The tree is of wood, and consists of pommel, cantle, and two side-bars, without stuffing, to which the leather flaps are fastened. The horse's back is protected by a piece of felt, covered by a leather numnah, called "potnik." The seat of the saddle is formed by the horse-rug, called "woylach," folded four times, and secured by a surcingle. The horse-rug is used to cover the horse when bivouacking, and the double service to which it is put creates a difficulty in case of a sudden alarm. It is, therefore, intended to give the regular Cavalry a leather saddle-seat.[2] In front of the saddle are fastened two wallets and the cloak; behind it the forage bag, filled with oats, and a valise to which is attached the mess-tin. A picket-rope is carried in front of the rider; also a hatchet on the off-side of the saddle, and behind him hangs the hay-net across the horse's flanks. The chabraque, which weighed over 6 lbs., and covered the whole load, has now wisely been done away with. The horse, as it is, has to carry an equipment which, including two days' forage, weighs over 150 lbs.; so that, putting the rider with arms and accoutrements at 210 lbs., the full load on the horse amounts to 360 lbs. (nearly 26 stone). It is not surprising, therefore, that during the last Turkish war a great many horses broke down very soon, or that the military authorities, here as in other countries, should be turning their attention to the question of how the trooper's load can be lightened. Each squadron of cavalry carries with it eight hatchets, eight pickaxes, and sixteen scythes. A horse's daily ration consists of 4 garnez[3] of oats for the Guards (3 garnez for the Line and Cossacks), with 10 lbs. hay and 4 lbs. straw. When hard worked, the horses have a larger allowance. In summer, or sometimes autumn, according to an old custom which bids fair to fall into disuse, green food alone is given, part of the time in the stables, and part out at grass.

Lancers (now only of the Guard).

Tunic, dark blue, with scales and lappets.

Overalls.—Full dress, black, with red stripe; field service, French grey pantaloons, with boots.

Headdress, a black cap, with coloured ornaments distinguishing the regiment.

The other articles of clothing are the same as those of the Cuirassiers, except that the men wear woollen gloves.

[1] There is a party in the Russian Army in favour of doing away with the lance entirely.

[2] This has, we are informed, already been done; a new pattern of saddle having been adopted, the leather numnah of which has pockets. Cloak, &c., are carried as before. The girth has three bearings, to prevent rocking.

[3] The garnez is a measure, eighty of which go to the sack of oats, the weight of which ranges between 4 and 5 "pouds" (160—200 lbs.) The garnez thus weighs from 2 to 2½ lbs.

Equipments.—White leather waistbelt, carrying a revolver-case and two pouches supported by a strap over the left shoulder. The pouches contain 40 rounds of carbine ammunition.

A narrow white leather swordbelt, with short slings, is worn over the right shoulder.

Arms.—Front-rank men are armed with lance, sword, and revolver; rear-rank men, with carbine and sword. The lance is the same as that for Cuirassiers, but with black shaft, and is carried in a bucket on the right stirrup. The sword is curved, three feet four inches long, and weighing 2 lbs. 12 oz. The scabbard is of wood, covered with leather. The revolver is that in general use.

The carbine is the Berdan (pattern 1871), and in every respect like the Infantry rifle, except that its length is only four feet and its weight 7 lbs. 6 oz.

Horse furniture as for Cuirassiers.

Hussars (now only of the Guard).

Dress.—Tunic, scarlet, with yellow braid. Pelisse edged with black fur. Pantaloons, dark blue and braided. Busby with black horsehair plume and scarlet bag. A cloth cap worn in undress. The other articles of clothing are the same as for the Cuirassiers, only that the men wear woollen gloves.

Equipment.—White leather waistbelt, with sword-slings and sabretasche; white leather crossbelt.

Arms, the same as for Lancers.

Horse-appointments as for Cuirassiers.

Dragoons.

Dress.—Tunic, almost the same as that worn by the Infantry, except in the regiments of the Guard, which have a double-breasted one. Regiments are distinguished by their collars, facings, and collar buttons.

Overalls.—The Guard regiments wear for full dress dark-green overalls, with a double red stripe. For field service they wear, like the rest of the dragoons, French grey pantaloons and boots like all other cavalry. The Grenadiers of the Guard (mounted) wear a leather helmet, with a fringe of bearskin over the top from ear to ear.

The Guard Dragoons have leather helmets, and all other dragoons black Astracan caps, with the arms of Russia in front. In undress or on service the flat cap is worn. Other articles of clothing as for Hussars.

Equipment as for Lancers. The carbine is carried in a leather case slung over the left shoulder, so that the butt rests behind the right thigh.

Arms.—Dragoons carry carbines, bayonets, and swords; non-commissioned officers and trumpeters, swords and revolvers. Carbines the same as for Lancers.[1] Sword and scabbard, ditto.

Bayonet can be attached to the carbine for fighting on foot, and at other times is carried in a sheath which is fastened to the sword-scabbard.

Revolver as usual. So also horse furniture.

The Art of Riding in the Russian Cavalry.

Since the introduction of short service, expertness in the exercises of the riding-school has diminished; but, on the other hand, the regular Cavalry can ride across country much better than they did formerly. This is partly

[1] In 1880 a Commission recommended that all Russian Cavalry, except Cuirassiers, should be armed with the Infantry rifle—a measure which is being carried out, at any rate with regard to Dragoons, who have already been seen to march past the Emperor on foot carrying the long rifle with bayonet fixed. It is slung on the back of the mounted dragoon in a leather case.

owing to the fact that the proportion of horses from the Steppes is constantly increasing in the service—a class of horse whose build and action are not very suitable for parade purposes, but which is eminently fit for the field, being active, enduring, clever, and sure-footed. Again, the practice introduced of late years of brigading Cossack regiments with the regulars, has produced an excellent effect upon the field-riding of the latter; whilst the former have, owing to this connection, improved in steadiness and regularity of movement. A strong feeling has of late shown itself in the Russian Army in favour of the Cossacks as the *beau idéal* of cavalry, and of substituting the snaffle, at present peculiar to the Cossacks, for the bit now used by the regulars. Riding-schools are rather scarce, and therefore mounted drill becomes often a great hardship for the recruit in winter, as it must be carried on in the open air, and frequently during hard frost. Recruits always ride with reins until just before they take their place in the squadron, when they go through a few rides without them. Recruits' drill goes on till the 1st May, when riding commences with spurs and in close order. Immediately after the recruit begins to ride with spurs, he begins to practise the sword-exercise on horse-back. Great attention is paid to this, as also to vaulting on the wooden and real horse. The young soldier is taught to vault upon his horse whilst the latter is at the walk, trot, or gallop; this branch of training being concluded by practice in mounting on, and dismounting from, a horse in movement and fully caparisoned.

The paces for Russian Cavalry are, at the walk, 125 paces in the minute, equal to about 3¼ miles an hour; at the trot, 300 paces in the minute, equal to about 7½ miles an hour; at the gallop, 400 paces in the minute, equal to 10⅓ miles an hour; at the charge, 800 paces for the first minute. Much attention has been paid of late, here as in Germany, to keeping up a fast pace for a considerable time, and, during the summer drills, practice of this description is conducted on courses prepared for the purpose, the time taken in going over a certain distance being carefully noted. These drills last from one to two hours, the horses being kept at the walk, trot, and gallop in turn.

Then comes drill in marching order, and chiefly at a rapid pace, the duration of which is gradually lengthened to three or four hours.

Marches are also made, with full field-equipment, for long distances up to 23 miles out and back, outpost and reconnoitring duties being practised on the way; and, according to the new regulations which came in force in the spring of 1882, exercises of this description are to be carried on for several days in succession towards the end of winter. One great obstacle to improvement in cross-country riding has hitherto been the small partiality for it shown by Officers, who, not being found in chargers by the State, but only receiving one horse ration, with the right to remount themselves every fifth year from the Government establishments at the regulated price, kept but one horse, and seldom rode except on duty.[1] Grand Duke Nicholas the elder did a good deal towards remedying this defect, by insisting upon it that all Officers of means should provide their own horses, and use them for riding instead of for driving, as was their custom formerly. Encouragement was also given to sport, and all Cavalry regiments, as well as Horse Artillery batteries, are now compelled to have annual steeplechases (distance nearly 1¼ mile), in which Staff as well as Regimental Officers must take part. The Cavalry Officers of the Guard, who still have no chargers found for them, keep a good many race-horses. There are great military races at St. Petersburg every year. But notwithstanding all these inducements, Russian Cavalry do not, as yet, excel, in cross-country riding.

[1] Since September, 1881, Line Cavalry Officers, except those commanding regiments, are supplied with horses by the State.

Regulations for Drill and Instruction.

Those now in force date from 1881, and are complete, except the part concerning fighting on foot, which is still in course of preparation.

A careful distribution of time for the exercises of the whole year has been made, and is now generally carried out. The arrangements under this head will be noticed when treating of the system of instruction for the army in general.

The great object aimed at by those who compiled the present Cavalry Field Exercise Book was to attain greater handiness, pliability, and rapidity of movement, so as to be able to show front as quickly as possible in all directions. In order to attain this, the bugbear of inversion was dispelled, and the German system of squadron columns and deployment was introduced.

All means were taken to encourage individual initiative amongst Officers, and they were authorized to depart from regulation upon their own responsibility.

The Squadron consists of four equal sections, which are drawn up with non-commissioned officers upon each flank of the front-rank men, who stand bridle to bridle, and are told off by files and by threes throughout each section, as in Germany, instead of throughout the whole squadron, including commissioned Officers, as was the case formerly. All squadron Officers are in front, and should there be two to a section, each posts himself one pace in front of the second file from a flank. Should there be only one Officer to a section, his post is in front of the centre, in case of one of the centre sections, but in front of the second file from the outer flank in case of the first or fourth sections. There are no serrefiles, even when, as it sometimes happens, there are seven or eight Officers besides the squadron leader. One pace behind the rear rank is the line of non-commissioned officers, serrefiles, with the sergeant-major in the centre. The squadron leader is at division distance in front of the centre.

Columns may be formed of divisions, of threes, of sections of threes, of files, and single file. The column of sections always marches by the right. When sections wheel by trumpet signal, it is done at the trot.

Attacks are made both in close and in extended order ("*en fourrageur*"). When attacking infantry or cavalry on open ground, the rule is to break into a trot at 2,000 paces from the enemy, into a gallop at from 700 to 800 paces, and into the charge at 300 paces. The rear-rank men keep at two paces distance from the front rank. Charges in extended order may be commenced at once from the halt, as well as by a body in movement, the pace being gradually accelerated as above described. The former method is applicable to the pursuit of a retiring enemy; the second to attacks upon very distant bodies of cavalry or artillery. As a general rule, men extend at the gallop, taking up the trot when their extension is completed. Should, however, it be intended to extend at charging pace, and the same pace to be kept up afterwards, the "charge" will be sounded. As a rule, only half the squadron is extended, the other half remaining in support; but sometimes the whole squadron is extended. After an attack, the skirmishers always close to the centre, the support moving up towards them. Should the skirmishers be recalled by order after closing, they move by sections to the flank of the support on which they have to form. Should, however, the "assembly" sound, the skirmishers rally at full gallop, and independently on the formed body, or if there be none, on the squadron leader. Charges are always directed on some visible object, first at a known, afterwards at an unknown distance. They are first practised against an imaginary enemy, afterwards by one body of cavalry against another, in which case the movement is timed, and the opposing bodies ride through one another's ranks. This is done at first only by Officers

and non-commissioned officers, afterwards by sections, and so on. The opposing parties are posted first at 3,000 paces from one another.

Four particularly well mounted men are selected from each section to act as scouts ; *i.e.*, 16 for the squadron. An Officer is selected to command them, and has a non-commissioned officer and a trumpeter attached to him. When the scouts of one or more sections are called out, they assemble in front of the squadron to receive their instructions, and then ride off to their destination, generally in groups of four ; they carry their swords drawn. Besides these scouts, each squadron has six picked troopers or non-commissioned officers, called "dosory," or watchmen. When the squadron is advancing, two of these men ride in front ; when it is retiring, the other two keep behind, the remaining two being told off, one to precede the squadron, if taking ground to the right, the other to perform the same office in case of a movement to the left. They keep at about 300 paces from the squadron, and communicate by signal with the chief.

Small piquets are further employed for the purpose of observation, each consisting of two or three or more troopers under an Officer or non-commissioned officer. It will be seen, therefore, that outpost and reconnaissance duties are well provided for in the squadron.

The *Regiment* when in line has its four squadrons at section interval. They may be either in the proper order of their numbers, commencing from the right, or they may be drawn up without regard to this order. Squadrons 1 and 2 constitute the right wing, Squadrons 3 and 4 the left wing, each under a commander whose post is in front of his wing. When the squadrons are not standing in the order of their numbers, the wing Commanders must be told which squadrons they are to command. There is a fixed post for each Officer, but field Officers and squadron leaders may quit these posts when their duty can be performed better elsewhere ; but subalterns leading sections remain under all circumstances, even in close column, in front of their respective sections. The senior Officer after the squadron leaders, is in rear of the regiment, in rank with the serrefiles. If there are two standards with the regiment, one remains in the centre of each wing ; if there be only one, it is placed between the wings.

Columns of *route* are formed in the same manner as by single squadrons, each of the latter keeping section distance from the one before it.

Regimental column of Sections.—Each squadron breaks into column of sections, following that before it at half-squadron distance.

Regimental column of Squadrons.—Either an open column, when each squadron keeps five sections distance from the one before it, or a close column with one section plus five paces distance.

Section leaders in front of their sections ; squadron leaders and field Officers on the directing flank.

Reserve columns.—The squadrons, each formed in column of sections, are drawn up in line at seven paces interval.

Line of *Squadron columns*, with full intervals. This is the normal preparatory fighting formation. Squadrons are in columns of sections.

Line of Squadron columns by wings is also used, which is virtually a *double-regimental column of Sections*, with full deploying intervals between wings.

Wing and squadron Commanders repeat the regimental Commander's cautions ; but section leaders do so only if their sections are specially named, or if the voice of the squadron leader is not clearly heard. The executive order was formerly only accompanied by a wave of the sword, but of late the practice of replacing this by a trumpet signal in particular cases has been introduced. Deployment and changes of front on the move are always executed at an accelerated pace. A movement in retreat is on no account to be carried out at a quicker pace than the trot.

Line is formed from regimental column always on the leading fraction, and to the left of it unless otherwise ordered. When an open regimental column of squadrons, or a line of squadron columns of sections at full intervals, is required to form line to the front, each section moves obliquely to its proper post, instead of making two wheels of quarter-circle, as was the former practice.

When line is formed from *reserve column*, the two centre squadrons form to the front on their inner sections, whilst the other squadrons wheel outwards by sections, and, when they have got their proper distances, wheel up again and form line on the centre squadrons.

At the special request of the Emperor, the old movement of retiring by échelon of wings, each of which shows front alternately to cover the retreat of the other, has been retained.

Échelon movements, both to front and rear, and also to a flank, are much practised, both from line and from squadron column. The "half-column" formation of the Germans, *i.e.*, the movement in oblique échelon of squadrons, after wheeling up the eighth of a circle, is much used. Line may be formed on the leading body of an échelon, either by those in rear accelerating their pace while that in front moves on steadily, or by making the latter move at a walk or even halt. A regiment must never charge in one line, unless its flanks be covered by other troops; if this is not the case, a portion of the regiment must always be held back in reserve. When acting against cavalry, the rule is to show as wide a front as possible, and to aim at turning the enemy's flanks. In all other cases, especially when charging formed infantry, the attack should be made by successive lines not less than two in number. The scouts and flankers of each squadron are under a non-commissioned officer, an Officer commanding those of the wing (two squadrons).

Part III of the new Field Exercise Book, which treats of the formation and evolutions of large bodies of cavalry combined with horse artillery, is still under preparation. The general principles which appear to have been adopted are those which now prevail in the German cavalry, and which are so well known to tactical students.

Russian organization is, however, not favourable to the full development of the German system, as the Cavalry Division consists only of four regiments instead of six as in Germany; consequently the formation of three lines for attack, adopted in the latter country, cannot so conveniently be carried out in Russia. For the present, therefore, the rule is to form two lines, from the first of which (the fighting line) detachments are kept back on each flank at a distance of some 200 or 300 paces in support, whilst the troops in the second line are massed about 400 paces in rear of the supports of the first line as reserve. The division, when formed for action, is always preceded by a chain of skirmishers. Its front is from 500 to 1,000 paces, according to whether one or two regiments are in first line; its depth from 700 to 900 paces, with the normal formation just described—1,500 paces if formed in three lines (one regiment in first line, two in second, one in third). The distribution of regiments in two or more lines is left to Generals of Divisions and of Brigade, if the latter be acting independently, although, as before remarked, the formation in two lines is considered the best by those in authority under present circumstances. It does not seem, however, improbable that the present organization of the Division in four regiments will ere long be discarded, and that the German organization of six regiments to the Division will be adopted—a change which will doubtless be followed by a corresponding tactical alteration.

When in reserve the four regiments of the Division are formed sometimes in regimental columns of squadrons, but more frequently in *reserve columns*, in two lines by brigades, with the artillery 60 paces in rear of all. The front is thus 300 paces, and the depth 375.

Fighting on foot is in great favour with Russian cavalry, including the

Cossacks, particularly since the introduction of the Berdan musket and carbine. The new Book of Musketry Instruction establishes conditions for the target practice of cavalry approximating to those in force for infantry, and in like manner the rules laid down in the Cavalry Field Exercise Book for fighting on foot in extended order are pretty nearly the same as the last new regulations on the same subject for infantry. The difference which formerly existed between the foot drill of Dragoons and Cossacks from that of Lancers and Hussars has almost disappeared; and, were it not so, the matter would be of little consequence now that all the Line Cavalry is converted into Dragoons.

Numbers 1 and 3 of threes dismount, No. 2 remaining mounted as horse-keeper; thus two-thirds of the men are available for skirmishing. Men of a section are kept together, amounting, with Dragoons, to ten or twelve file, with Cossacks to eight or nine file. Squadron leaders dismount and take command of the parties on foot. A detachment remains mounted, to protect the horse-keepers and horses, who are placed under cover as close at hand as possible. Dismounted cavalry are trained, like infantry, to throw up earthworks and charge with the bayonet; in fact, the aim is to make cavalry feel itself able to act independently under all circumstances, and it is hoped that without sacrificing the efficiency of cavalry in its primary employment, that of fighting on horseback, it may be possible at the same time to train it so thoroughly for dismounted action as to place at a Russian General's disposal a great mass of horsemen provided with entrenching tools and fit to measure themselves on foot with the enemy's infantry, whilst equal, when mounted, to any encounter with his cavalry. A force of this description, acting in front of the main army or on the flanks and rear of the enemy, will doubtless exercise a great effect in warfare. The question, as yet undecided, and about which opinions in all countries are much divided, is whether troops can be made to act with real and equal efficiency both on foot and on horseback. The Russians are preparing to try the experiment on a very large scale. The result will be watched with interest. Firing from the saddle is only allowed with the revolver, or exceptionally to give the alarm, and horsemen are taught that the sabre is their only arm for attack, which must always be conducted with the utmost energy.

Training for Field Duties.

In the remarks upon this branch of instruction, as imparted to the Army in general, we shall touch upon its application to Cavalry; but we may here notice some details in the new regulations for summer drills, specially relating to the mounted branch of the Service, and to its instruction in field duties, to which particular attention is devoted, and which is systematically conducted. This instruction commences in winter with the theoretical part, followed up in spring with the elementary and mechanical part of the practical course, on foot. Then come reconnoitring rides of Officers and non-commissioned officers; after which exercises with a tactical idea over varied ground, squadron against squadron, then Division against Division, starting at distances from one another resembling the probabilities of active service, say from one to two miles. These exercises last in the first instance for twelve hours, increasing in length to twenty-four hours at a stretch, being carried on both by day and night, giving the opportunity to practise field duties in all its branches, such as distant patrols, reconnaissances both of the ground and of the enemy, outposts, care of horses in the field, &c. Every endeavour is made to imitate the real thing as nearly as possible, and to keep the attention of all parties alive by changes of position at night, by sending scouts to penetrate by surprise into the position of the opponent, by laying ambushes and such like. Officers are required to make sketches of the ground, and reports upon the enemy. They must also, as well as the non-commissioned officers, be thoroughly acquainted with their own position. The latter are taught to read maps and to make

slight sketches. The director of the manœuvre, who is also the umpire, communicates to each party only what it might fairly be expected to know about its opponent in actual service; they must find out everything else for themselves. The manœuvre generally ends with a charge, after which comes the critique. In all these exercises of one body against another, representing the attack and defence of a convoy, the protection and destruction of a railway, the assault on a post, and in fact the many minor operations of war, much greater attention is wisely paid to the execution of the preparatory movements than to the actual conflict.

At the great manœuvres, for instance, at Krasnoe Selo and at Warsaw, Cavalry is used in the most thorough and extensive manner for reconnaissance and outpost work, forming bivouacks while thus employed.

Another opportunity of the same nature is afforded by the winter marches with troops of all arms enjoined by the new regulations, and carried out, as it would seem, by the troops of the Petersburg district in February, 1882.

The advantage to be gained by the last-named exercise is somewhat doubtful.

Much is done to improve the tactical and strategical instruction of Officers by the use of the war-game, by working out tactical problems on the ground, and by other such means; but as yet the same want is felt in the Cavalry as in other arms, of advanced professional knowledge amongst the superior Officers, owing to which the education of the younger Officers suffers.

In order to remedy this defect, a special course of instruction for field Officers has been provided at staff head-quarters and at military colleges, whilst the tactical educational standard for cadets has been raised.

Although the use and employment of *Divisional Cavalry* are discussed in Russian tactical manuals, and although, during their last war, cavalry was attached in larger or smaller numbers to the Infantry Divisions, the same course being also pursued at the great manœuvres, it has not as yet been customary to attach a cavalry regiment permanently to each Infantry Division, partly perhaps because there is a prejudice against doing so, lest the true cavalry spirit may be dulled by close connection with infantry, but principally because of the tendency to put off to the last moment the brigading of cavalry with the other arms, so as to have the opportunity of assigning to each commander a larger or smaller proportion, according to the requirements of the moment and to the leader's characteristics. Moreover, the present organization does not lend itself readily to the permanent allotment of cavalry regiments to Infantry Divisions, a Cavalry Division consisting, as we have seen, of only four regiments, being attached to each Army-corps comprising from two to three Divisions of infantry. This comparatively small body of horsemen allotted to the Army-corps is evidently unable to supply Divisional Cavalry without damaging its own fighting efficiency, as demonstrated during the last war. Two plans have been proposed for the purpose of overcoming this difficulty—either to increase the strength of Cavalry Divisions to six regiments, which is also desirable, as already noticed, for tactical reasons, or to employ the forty Don Cossack regiments of the second and third category (see page 237), which are to be embodied in war time as Divisional cavalry, keeping the present eighteen cavalry Divisions intact; but the latter combination is not a likely one, on account of the inevitable delay in mobilizing the Cossack regiments, which would only be ready to take the field four weeks after the order is issued.

The tactical employmemt of Divisional cavalry and of cavalry Divisions, respectively, is theoretically the same in Russia as in other European countries, particularly Germany.

The use of cavalry in large bodies for strategetical purposes, that is to say, for independent enterprises against an enemy in process of concentration, or against his communications, or again for screening the advance of its own

main army, for temporary occupation of an invaded district, and for other similar purposes, appears to be fully appreciated in Russia, with the consciousness too of the large means available for such undertakings; for although the proportion of Cavalry to Infantry in the standing army is small in Russia compared to what it is in Germany, there being only twenty-one Divisions of regular cavalry, including that of the Caucasus and the first category of the Don Cossacks, against forty-eight Divisions of infantry, the former, too, weaker and the latter stronger than those of Germany, so that, allowing the usual number of two infantry Divisions to the Army-corps, there would be five Army-corps without any cavalry, whilst each of the others would have only from eighteen to twenty-four squadrons and sotnias, still, independently of the forty extra Don Cossack regiments to be raised on the outbreak of war, and to be formed into ten Divisions, which would join the twenty-four Russian Infantry Divisions then also to be organized, there would be still further supplies of horsemen from the Don territory, besides some thirty or forty regiments of Cossacks from Astrakhan, the Caucasus, the Ural, and Orenberg, all which levies would join the armies in second line, and be pushed to the front later on if required. Moreover, it is in contemplation to increase the strength of the regular Cavalry, for doing which there are abundant means.[1] All things considered, therefore, Russia may well feel confident of her ability to pour, as soon as war is declared, the nine or ten regular Cavalry Divisions kept at all times complete, together with their Horse Artillery, over the western and south-western frontiers, near which they are permanently stationed, and to support these afterwards with further masses of mounted men. The excellent firearm now issued or in course of issue to the Russian trooper, the thorough training in its use which he is receiving, combined with careful instruction in throwing up field-works, and, lastly, the Horse Artillery attached to Cavalry Divisions, should render them capable of independent action; and for such they are being carefully prepared in peace: witness the manœuvres in the Warsaw and Wilna districts. The constitution and distribution of cavalry Divisions or corps for great strategical movements are much discussed, and the question at present remains unsolved. The views of Russian tacticians upon the subject may be gathered from Drygalski's book on new Russian tactics, published at Berlin in 1880, to which we refer our readers for detailed information. They will see that there is in the Russian service a school of thinkers who discard the idea of employing regular cavalry in the manner hitherto habitual in European armies, as quite out of place in these days, and who advocate the use of mounted troops after the American fashion, to which they consider the Cossack nature admirably adapted.

(To be continued.)

INFANTRY FIRE *v.* ARTILLERY FIRE.

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The physical effects of artillery fire and its intrinsic destructiveness as compared to the fire of infantry are questions of great interest which are frequently discussed at the present time. Although the limited experience of the Egyptian Campaign speaks well in some respects for the future of artillery, yet the opinion generally entertained of the power of this arm is assuredly not a high one.

[1] This, as we have before noticed, is already in course of execution.

It is not intended to discuss these questions fully in the following remarks, but, inasmuch as the well-known comparative statistics derived from the Franco-German War of 1870–71 are frequently quoted in works on Tactics and elsewhere in connection with this matter, and considerable weight appears to be attached to them, it is proposed to endeavour to ascertain what is their real value, and whether, when brought into court, as they so frequently are as witnesses against the gunners, they carry conviction solely because no one cares to cross-examine them and elicit all the facts of the case.

These comparative statistics are given as follows :—According to the late Colonel Home, in a note at p. 86 of "A Précis of Modern Tactics," 94 per cent. of the Prussian loss in killed and wounded at the Battle of Gravelotte was due to infantry fire, 5 per cent. to artillery fire. Captain Thival, in a note at p. 291 of "Rôle des Localités à la Guerre," quoting from the "Revue Maritime et Coloniale," gives the Prussian losses of the whole campaign as 88 per cent. from infantry fire, 5 per cent. from artillery fire, and 5 per cent. from mitrailleuse fire. It is presumed that by the word "Prussian" "German" is intended by these writers. In the latest edition of "The Soldier's Pocket Book," is accepted, at p. 375, 90 per cent. as hit at the Battle of Gravelotte by the Chassepôt bullet, and 6 per cent. by artillery projectiles, whilst at p. 112 the percentages of the whole campaign are given as 91 per cent. due to infantry fire and 9 per cent. to artillery fire.

It is, at the outset, desirable to remark that obviously these statistics can at the best be but approximately correct, and can be regarded only as comparative statements and not as actual facts.

The first step in the investigation is to ascertain what kinds of weapons were in the hands of the troops which inflicted the losses. The necessary information will be found in the third chapter of Captain Ellis's, R.A., translation of "The War of 1870–71, by M. A., a Prussian Artillery Officer." The superiority of the French Chassepôt, with its small calibre, flat trajectory, and long range, over the Prussian needle-gun, not thoroughly effective at a greater range than 400 paces, is so well known that it would be superfluous to quote on this matter from the work ; but the indifferent character of the French artillery and its inferiority to the German artillery is not generally realized. The French field artillery was composed of 4-pounder, 8-pounder, and 12-pounder guns, but the last-named were becoming obsolete as field guns, and were, therefore, in use in limited numbers only : they were placed in the Reserve of the Corps d'Armée. The Prussian guns were 4-pounders and 6-pounders.

The projectiles used were as follows :—

	Common Shell.		Shrapnel Shell.		Rounds of Case.
	Weight.	No. of rounds per gun with the battery.	Weight.	No. of rounds per gun with the battery.	
	Lbs.		Lbs.		
French 4-pr.	8·886	170½	9·403	20⅔	20⅙
Prussian 4-pr.	9·37	144	Nil		9
French 8-pr.	16·22	83⅓	19·29	8⅓	8⅓
Prussian 6-pr.	15·202	123	Nil		7
French 12-pr.	26·45	..	25·99	..	..

The range of the French 4-pounder common shell is a little over 3,000

mètres, but the fuze employed (a time fuze) rendered it possible to burst the shell at two distances only, 1,500 and 2,800 mètres. At all other ranges the shell had very little effect. Since at the long ranges the projectiles could only be used as solid shot, and the accuracy, besides, was not great, the rule obtained in the French Artillery, only in exceptional cases to fire at longer ranges than from 1,200 to 1,500 mètres. The fuze used with the 4-pounder shrapnel shell rendered it possible to burst the shell at four ranges, which lie between 500 and 1,300 mètres. The same fuzes were used for the 8-pounder. A similar fuze was used for the 12-pounder shrapnel bursting at four ranges between 500 and 1,400 mètres, and probably the same kind of fuze was used for the 12-pounder common shell. From the table given above, it will be seen that with only a very small proportion of the projectiles could the least ineffective fuze be employed. The Prussians used a percussion fuze, and it is stated that the third trial shot found the range. The foregoing facts should always be kept carefully in mind when considering questions of tactics connected with or arising out of the Franco-German War.

We are now in a position, therefore, to proceed on the enquiry, why, at the Battle of Gravelotte, only 5 or 6 per cent. of the casualties are due to the effect of artillery fire against 90 or 94 per cent. due to infantry fire?

According to "Die Verluste der Deutschen Armeen an Offizieren und Mannschaften im Kriege gegen Frankreich, 1870 und 1871, von Dr. Engel, Director des Königlich-Preussischen Statistischen Bureau," the losses sustained by the Germans in this battle were as follows :—

Corps.	Killed.	Wounded.	Missing.	Total.
Guard	1,959	6,016	144	8,119
IXth	1,056	3,181	200	4,437
VIIIth	697	2,550	145	3,392
Saxons	415	1,644	167	2,226
IInd	143	965	248	1,356
VIIth	145	587	31	763
Xth	16	81	3	100
1st Cavalry Division	9	85	..	94
IIIrd Corps	9	78	1	88
Ist Corps	..	1	..	1
5th Cavalry Division	..	1	..	1
Total	4,449	15,189	939	20,577

From these figures it appears that almost two-fifths of the whole loss fell on one corps alone, namely, the Guard Corps. It will be instructive to learn how this heavy loss was incurred. On looking into the accounts of the battle, it will be found that the regiments which suffered most severely, attacked late in the afternoon that portion of the French position which extended from St. Privat on the north to the railway running north of Amanvilliers on the south. The 1st and 3rd Foot Guards stand highest on the list of casualties. They attacked north of the St. Privat, Ste. Marie-aux-Chênes Chaussée, and they lost in a very short space of time 1,058 and 1,090 respectively. The German official account tells us, at p. 131, 6th Section (Major Clarke's Translation) : "At a short distance in front of the west and north sides of St. Privat there were several parallel walls of knee-high masonry, while at some places the adversary had thrown up shelter-trenches. These lines, successively commanding one another, were filled with compact lines of skirmishers, and in their rear, upon the commanding height, lay like a

natural bastion, and girt with an almost continuous wall, the town-like village, the stone houses of which were occupied up to the roof storey." We may here say, that from personal inspection of the ground, it is difficult, if not impossible, to get out of view of the village, on the ground over which these regiments advanced. "The (French) guns posted since the commencement of the engagement to the west and north of St. Privat were, it is true, already silenced in front of the Saxon Artillery, and had retired; on the other hand, from the south side of the village, heavy batteries swept, in the most effective manner, the ground to the north of the road. . . . . As soon as the brigade reached the east side of Ste. Marie" (distant 2,800 paces from St. Privat), "an extremely heavy fire of artillery and musketry was directed from the opposite lines of the enemy against these newly-appearing bodies of troops."

Before proceeding further in the enquiry, it is well to see what the value of this artillery fire can have been, and for this purpose we will turn first to the account given by Lieutenant-Colonel de Montluisant, who commanded the Reserve Artillery of the French Corps, the 6th, now attacked, at pp. 19 *et seq.* of his work—"1870, Armée du Rhin, ses épreuves la chûte de Metz." We read: "Everywhere (on the German side) there was an abundance of ammunition, the fire was incessant, concentrated, sustained, and remarkably accurate. On the French side, on the left of St. Privat, were only 6 12-pounder and 10 4-pounder guns. Total 16. On the right 6 12-pounders and 54 4-pounders. Total 60 pieces. There was no park, not a single mitrailleuse battery, and there were not more than 100 rounds per gun. Ammunition ran out only too fast; it was necessary not only to slacken fire, but to reduce it to one round every quarter of an hour, and finally to cease firing altogether, reserving 10 to 15 rounds per gun, to meet future unforeseen attacks." To the 60 French guns north of St. Privat, which had, moreover, to guard the ground as far as the Bois de Jaumont, were opposed in a mass from St. Privat to the Anbouê Copses 72 Saxon guns, which, according to Hoffbauer ("The German Artillery in the Battles near Metz," translated by Captain Hollist, R.A., p. 236), were "principally occupied in subduing the fire of the enemy's guns between St. Privat and Roncourt, and in preventing him from advancing to impede the Saxon turning movement. Consequently the enemy's artillery was generally the object of our fire. . . . The practice made by these 12 batteries was excellent, and obliged the hostile artillery to withdraw." And further, p. 279: "The left wing of the Saxon artillery overwhelmed Roncourt with shell. . . . The right wing also fired with equally good effect against St. Privat, and the batteries placed north-east of that village, until at length only a few of the latter still held their ground." To the 16 guns south of the village had been opposed soon after 3 P.M. a mass of 108 guns between Ste. Marie and the railway. "At the beginning of the battle," says Hauffbauer, p. 231, "the French artillery was the principal object at which the Hessian and Guard batteries aimed. . . . The immediate result of their concentrated fire was the withdrawal of the enemy's advanced batteries to his main position, where his artillery was so strongly posted as to necessitate a lengthened cannonade, so that it was 4 P.M. before the French fire perceptibly slackened, and at 5 P.M. it died away almost entirely. After this only a few fresh batteries came into action. The left wing (*i.e.*, . . . the Artillery of the Guard) kept the hostile artillery opposed to it in check from the very first, and diverted its fire from the right flank of the infantry advancing from the south against Ste. Marie-aux-Chênes. . . . The enemy's common shells were more effective than his shrapnel, which generally burst too high; but the principal loss was caused by the Chassepôts of his skirmishers, who lay under cover in the furrows, as well as in the ditches of the high road between Ste. Marie and St. Privat."

From these extracts it is evident that the artillery fire on the 1st and 3r

Foot Guards could not have been very severe; in fact, Colonel Montluisant, though himself an artillery Officer, and therefore naturally inclined to give the fullest credit to his own arm of the Service, attributes (p. 21) to the grazing fire of the 9th Battalion of Chasseurs at St. Privat, the check sustained by this brigade. Captain v. Kessel, in the "Geschichte des König Pruss. Ersten Garde-Regiments zu Füss.," says, at p. 154, that already when "the two regiments were lying on the exposed plateau, 500 paces south of Ste. Marie, the German artillery in rear were successfully diverting from them the fire of the French guns, but they were under the fire of French infantry which could not be replied to on account of the inferiority of the German weapon. Whenever mounted Officers got together the bullets were sure to fall in large numbers, and the groups had to separate. Occasionally a shell burst in their vicinity." At p. 156 we read in the account given by General v. Kessel, the Brigadier, "The Chassepôt bullet, still effective after several ricochets, disregarded the distances between the lines altogether." This grazing fire of the Chassepôt stands out forcibly throughout the narratives. The 2nd Foot Guards, which attacked somewhat later over the same ground, suffered the same fate as its predecessors, and with a loss of 1,075 men. South of the Chaussée had advanced in front of the 108 guns, to the attack of the position, the 2nd and 4th Grenadier Guards. The small force of artillery in front of them has already been mentioned. The official account, p. 128, describes this attack as follows: "Dense swarms of French skirmishers covered the slope and the ridge. On the latter they had ensconced themselves in shelter-trenches and behind hedges, which partially enclose the cross-road leading over the ridge, whilst the water channels intersecting the fields at distances of about twenty paces offered the assailant a cover which was in truth most insufficient. Even during its deployment at St. Ail, the Prussian brigade found itself overwhelmed by a shower of bullets which accompanied the advance with annihilating effect. The ground was so hard from the continuously dry, hot weather of the last few days, that the Chassepôt bullets, after striking, rebounded, and in this way still found their mark." As regards the 4th Grenadier Guards we read, p. 129, "The left wing of this attacking line of fourteen companies (including two of the 1st Grenadier Guards) was advancing partly in a direct, partly in a flanking direction against the hedged lane, whilst the extreme right wing had been deputed to turn the left of the enemy's salient position. At the signal of the regimental Commander, Colonel Count Waldensee, the whole line charged forward towards the heights. The enemy's volley firing rent the companies asunder . . . and the frontal attack at that point broke down shortly under the shower of bullets of the adversary who had apparently been reinforced by fresh troops." The part taken by the French artillery in repelling this attack is thus briefly described by Colonel Montluisant at p. 20: "The French batteries placed to the left of St. Privat resisted most energetically the advance of the enemy. Each 12-pounder shell makes a chasm, causes indescribable disorder; but, the ammunition ran short, and Prince Hohenlohe still advanced in échelon with his fourteen batteries." The losses of these two regiments stand fourth and fifth on the list of casualties, being 1,059 and 929 respectively. It may then fairly be deduced from the foregoing extracts that so many victims fell to the Chassepôt for the simple reason that it was against the Chassepôt, firing over ground most favourable for its shooting, that the victims advanced. Some must have been struck down by artillery fire, but these could not have been many, seeing that the guns were few in number, were short of ammunition, and were held in check by a superior force of guns, by which they had already been partially silenced. As regards the losses incurred by the remaining regiments of the corps, we find these attacking south of the railway, and opposite Amanvilliers where the French artillery fire had been already silenced. (Hoffbauer, p. 270.) Of the 1st Grenadier Guards two

companies had joined in the attack on St. Privat; the other eight available companies came into action against Lorencez's entire division, about thirteen battalions strong, and further reinforced. (Hoffbauer, p. 272.) The second battalion encountered the resistance of strong detachments of infantry of Grenier's division (Official Account, p. 121), and afterwards joined in a hand-to-hand fight in the vicinity of Amanvilliers (Official Account, p. 125). In these almost purely infantry engagements the regiment lost 823 men. The battalion of Sharpshooters of the Guard (Official Account, p. 121) attacked troops well posted, came into a murderous shower of bullets poured in upon the front and both flanks of the battalion, and lost 461 men, including all the Officers. The 3rd Grenadier Guards entered here still later into action, and employed but a small portion of the regiment till nearly all was over. The Chassepôts were their enemy here, and the loss was 445 men. The losses of all the regiments of the corps have now been accounted for, and if the writers of the works named are to be trusted, the Chassepôt obtained the vast majority of the casualties for the reason before given, that it was against the Chassepôt that the attacking troops, in some cases as at St. Privat, ten men to the pace, were led. The French artillery had but a small part to play in the struggles.

It is not necessary to carry much further the analysis of the losses of this battle. The Fusilier Battalion of the 85th Regiment loses 12 Officers and some 469 men in a vigorous counterstroke met mainly by Chassepôt and mitrailleuse fire. (Regimental History, p. 27.) The same story is repeated on the right of the line approaching Gravelotte, where the 60th and the 33rd Regiments lose respectively 718 and 639 men. General Frossard, in his "Rapport sur les Opérations du 2me Corps," p. 108, says, that "the German artillery having got the better of his own guns, the German infantry were sent forward across the Mance Valley. The infantry and mitrailleuse fire stopped the advance and drove the enemy back into the ravine. Everywhere the infantry going to the attack find in the hostile infantry the means prepared to stop their further progress." Everywhere we find the same story, an overpowering German artillery fire silencing or holding in check the fire of the inferior French artillery, and the infantry regiments suffering in proportion to their efforts to advance to the assault against better armed hostile infantry, and everywhere, except in the centre, over ground singularly adapted to bring out the full powers of the superior firearm. It is hoped that this brief summary of the great battle of Gravelotte may contribute to shaking faith in the value of the Gravelotte percentages.

As regards the percentages of the campaign, I have carefully traced through a large number of the battles and engagements of the war, the part taken in each action by the two regiments whose losses were greatest, and with the almost unvarying result that I find these losses were occasioned as at Gravelotte by the troops advancing against infantry fire, the action of the hostile artillery being neutralized by the fire of the German guns. In some cases, as at Wissemburg, Worth, Colombey, Noisseville, Balan (Sedan), Bourget, Champigny, Etival, Dijon, Amiens, and la Hallue, the losses were incurred in village fighting, or the storming of heights.

From this enumeration the great battle of Vionville has been omitted because it requires special notice, as it appears to be a remarkable illustration of the enormous physical power of artillery, good in its material, and properly handled. But although I attach little value to the medical returns of percentages, yet if they are used against artillery they may also be used in its favour. In the note in Thival's work already quoted, the French percentage of losses in the campaign is thus given: 70 per cent. infantry fire, 25 per cent. artillery fire. This is something very different from the German Gravelotte percentage, and yet it is always ignored, or more probably it is not generally known. The facts of the battle of Vionville strongly support this statement

of the effectiveness of the German artillery fire. In giving a summary of this battle I have endeavoured to show the overwhelming preponderance of the French forces at different times of the battle, and the small destructive effect that could have been produced by the few German infantry compared to that produced by the German guns. The summary is taken from the official account, 5th section (Clarke's translation), my own "Tactical Studies," founded on it, and from Hoffbauer's previously quoted work.

The battle commenced at about 9.15 A.M. by the almost simultaneous entry into action of five German horse artillery batteries, the four on the left being separated from that on the right by a distance of about one mile, cavalry being the only escorting or protecting force. Shortly there came up into the interval the four batteries of the 6th Infantry Division, making a total of 54 guns ; but by 10 A.M. all, save one battery (that on the left), had to retire before the advance of the overwhelming infantry forces opposed to them, the only German infantry on the ground being two battalions of the 5th Infantry Division advancing on the right towards the Bois de Vionville. The French guns now coming into action are—

Lepasset's brigade 5th Army Corps....	6	battalions,	6	guns.
2nd army corps (Frossard)	26	„	60	„ 12 mitrailleuses.
6th „ „ (Canrobert).....	40	„	36	„
Total,—	72	battalions,	102	guns, 12 mitrailleuses.

Of these, Tixiers's Division of the 6th Corps, numbering 13 battalions and 18 guns, were only gradually brought into action ; the others were actually on the ground at the commencement of the fight. The French had at once moved forward, and were at 10 o'clock in possession of Vionville and Flavigny. At 10.15, however, the 1st Light Battery made its appearance on the battle-field on the left of the before-mentioned two battalions. It was overwhelmed by the enemy's bullets before it came into action, three guns were temporarily disabled, and the infantry, now three battalions, was fighting against the French Infantry in the wood. The three uninjured guns opened fire at a range of from 800 to 1,000 paces, and with such effect that the dense swarms of skirmishers were crushed, and obliged to retire. The three other batteries of the division now came into action on its flanks. Two battalions enter successively into the battle, in an isolated fashion, on the left of the guns ; but little help can they give. The first to arrive was the Fusilier Battalion of the 48th Regiment. Of it, three companies suffered at once such heavy losses that they had to retire in complete disorder to the Bois de Gaumont : of the next, the 1st Battalion of the 52nd, all the Officers were in a short time placed *hors-de-combat*, and the remainder had to retire to the valley in rear. But in the centre and on the left, affairs are progressing favourably. The artillery, reinforced by two fresh batteries, has, with one exception, come into action again. On the left the twelve battalions of the 6th Infantry Division have been brought on to the field in divisional formation, and are engaged in attacking the villages of Vionville and Flavigny, and in extending the German line still further to the north. By 11 A.M. the Germans have on the field, and nearly all actively engaged, 84 guns and 19 ($18\frac{3}{4}$) battalions. During the next hour this force is increased by the arrival in the centre of the 24 guns of the Field Division of the Corps Artillery ; whilst on the right 4 battalions of the corps, 2 battalions and 6 guns of the Xth Army Corps, and on the left, $3\frac{1}{2}$ battalions and 6 guns of the latter corps take part in the struggle. At noon the German force consists of 126 guns (the disabled battery having rejoined the line), and 29 ($28\frac{1}{4}$) battalions. Assuming that the 72 French battalions are numerically equal to only 54 German battalions, the Germans are terribly overmatched in this arm. But the result of the fight so far has been that the force weaker in infantry has established itself on a line some three miles long from near the

Roman Road on the north to the Bois de S. Arnauld on the south, has already captured the two villages already named, and in front of its right where its infantry were fewest, have driven back a whole French Corps, with a loss to the defeated of 4,327 out of an effective of 19,000 men. The losses, Frossard, the Commander of the Corps, attributes at p. 97 of his "Rapport" to the very heavy artillery fire (*un feu d'Artillerie des plus intenses*). By 3 P.M., when the battle entered its last great phase, the Germans counted 156 guns, and an additional battalion, whilst on the French side 3 Divisions of the 3rd Army Corps, and 2 Divisions of the 4th Army Corps, were coming into action, and the place of Frossard's Corps had been filled up from the Guard Corps. By the close of the battle there had come up into the German line 72 more guns and 32 more battalions, making a total of 228 guns and 61 battalions, 5 of which, however, belonging to v. Wedell's Brigade, had been defeated, after some half hour's fight, with a loss of about half their strength, and driven off the field by the freshly arrived troops of the French 4th Army Corps. At the close of the battle the French forces available, allowing for the absence of two Divisions and the reserve artillery of one corps, could not have been less than 161 battalions (=120 German battalions), 378 guns, and 54 mitrailleuses.

It is impossible to ascertain the exact number of guns or battalions which took an active part in the struggle on the French side, but we know that every gun and almost every battalion on the German side was under fire, although some for a short time only at the latter part of the day. But whilst the defeated battalions of Frossard's corps were at once replaced by fresh battalions drawn from the Guard Corps, and the infantry struggle was carried on as vigorously as ever in this part of the field, so far as the French were concerned, two battalions of the 5th Infantry Division on the right centre, and five battalions of Wedell's Brigade on the extreme left, were practically put out of the fight with enormous losses soon after they appeared on the field of battle, and could not be replaced. The loss of these battalions was a serious deduction from the German rifle fire. The battle was one in which both sides were equally on the offensive and the defensive, entrenchments were not employed on either side, and the struggle was fought out on similar conditions as regards attack and defence. But of the two man-killing weapons employed by each combatant, one was as superior, as the other was inferior to those in the hands of its foe. It follows, therefore, that inasmuch as the inferior rifle was in the hands of the numerically inferior infantry, the losses inflicted by the numerically inferior infantry on its opponent must have been far less than that it sustained at the hands of the numerically superior infantry, armed with the superior rifle. Yet, looking at the losses inflicted by one on the other, we find that whereas the French, with their Chassepôts, and indifferent artillery, inflicted on the comparatively small force opposed to them a loss of 14,825 men, these Germans, strong in their artillery, but deficient in infantry, put *hors-de-combat* 16,985 French soldiers. The inference is obvious (and is confirmed by Frossard's statement before mentioned), and is, that a very large percentage of this 17,000 men must have fallen under the fire of the German guns. I have purposely abstained, save in one instance, from quoting from Hoffbauer's work, details of the successful employment of the German guns. Artillery Officers naturally are inclined to attribute much of the results of a victory to the working of their own arm, but making allowance for any amount of pardonable exaggeration, his account of the battle affords indisputable evidence of the physical effects of artillery on the 16th August, 1870. It is hoped that enough has been adduced to lead Officers to discard in future the use of these German medical statistics in considering the relative value of infantry and artillery fire, as instruments of destruction, or in evidence of the small physical effects of artillery.

To some it may seem that it has been a waste of labour and time to analyze battles for the purpose of showing that the chief part of the losses incurred in action must be caused by infantry attacking infantry.

If the statistics which have served for the text of this article were employed in tactical discussions simply as illustrations of that most obvious fact, these remarks would never have been put on paper, but the truth is that they have been, and constantly are used in depreciation of the power of artillery, and for this use I maintain to the utmost that there is, from the historical point of view, no warrant whatever.

On the 16th August, 1870, on the field of Vionville, long-armed A commenced an encounter with long-armed B and his ally short-armed X, the latter being a big boy. Little short-armed Y, half the size of X, came to the assistance of his friend A ; and at the end of the fight, B and X were found to be much more knocked about than were A and his little friend Y, and for this satisfactory result, Y was duly grateful.

Two days later, little Y having grown a good deal, went hammer and tongs at his old opponent X, who got snugly behind walls and hedges and banks, where A could not get at him. Moreover, A and B had accounts of their own to settle, and paid little attention to their friends' fight. X and Y hurt each other very much, and ever after ungratefully abused their long-armed friends for cuffs and bruises which arose merely from their own wish to settle accounts between themselves.

But in conclusion there is yet a strong reason, in fact the strongest possible reason, why these statistics should be relegated to the forgotten past, and that is that the artillery which furnished the practice on which they are founded are obsolete. French and Germans alike, when they next meet in a campaign, will come with weapons and projectiles so superior to those employed during the Campaign of 1870–71, that the experiences of that war will be useless for practical purposes and practical soldiers ; and still more antiquated will assuredly these results appear to be, still more unreliable, when they are contrasted, as some day they may be, with the practice obtained by our own artillery, firing their steel shells from the 12½-pounder field gun.

A SHORT HISTORY OF THE IRON-CLAD TRAIN.

By Lieut. E. Warre Slade, R.N.

The object of this paper is to give a short account of the construction of the iron-clad train which attracted so much attention during the recent war. This is, I believe, the first time that a gun as heavy as a 40-pr. has been mounted and fought on a railway truck. Trains were utilized as a means of reconnoitring during the American war of Secession, and during the war of 1870–71, but, as far as I can ascertain, no heavier guns than those usually employed as field artillery were mounted on them. Unfortunately the 9″ gun was only got ready for action on the day that Kafr-Dowar surrendered, so that there was no opportunity of trying it against the enemy. It was, however, fired across Lake Mareotis and everything worked satisfactorily, so there is every reason to suppose that it would have been most successful against the enemy's works.

After the occupation of Alexandria by the Naval Brigade, the railway naturally attracted great attention, both on account of its enabling us to move men to the front with speed and facility, and also on account of the advantages which it gave to the enemy for suddenly making a strong attack on our position.

In order to guard against this latter contingency, the first train went out with a party to destroy the line between Gabari station and Mehalah junction. Lake Mareotis was at this time covered with water, and it was proposed to float a raft carrying Gatling guns on it in order to turn Arabi's position, and also to flank any offensive movement that he might make against the town. A second party was, therefore, sent out to reconnoitre and ascertain whether there was sufficient depth in the lake for that purpose, but as only a few inches of water covered the mud, the raft plan had to be abandoned.

As we pushed our advanced posts to the front the line was repaired, and a number of trucks were shunted through the junction to the Moharrem Bey station, in order to clear the Gabari station. The enemy, however, cut the line during the night, and on the next trip the engine went off the rails, effectually blocking the down line.

Captain Fisher ("Inflexible") then proposed to use the train as a regular means of reconnoitring, mounting machine and field guns, and protecting the engine against rifle-fire. Besides the Gatlings which had been used on former occasions, a Nordenfelt and two 9-prs. were added to the train. The sides of a truck were built up and strengthened with thin iron plates so as to form a protection to the crews of the 9-prs., which were placed on the truck with their limbers, so that they could be used as field artillery if necessary. Sand-bags were hung round the boiler of the engine to protect it from injury, and it was placed in the centre of the train. A truck carrying a steam crane came after the 9-pr. truck, for the purpose of lifting the guns off if required. A couple of spare trucks were put in front of the train, so that they could be pushed ahead and explode any mechanical mines that might have been placed under the rails. These trucks also carried spare railway iron, chairs, bowls, &c., for repairing the line. Besides these, there was a truck loaded with gun-cotton, detonators, Bickford's fuzes, &c., for destroying the line if necessary; a truck for the covering party, and a truck with a Gatling gun in rear of all.

The train thus constructed ran for some days, but as the enemy increased the strength of his works, it was found necessary to increase the strength of the train. Captain Wilson ("Hecla") proposed using heavier guns, and offered to land the "Hecla's" 40-pr. bow gun. The original idea was to place the gun on a truck and take it out with the train until within effective range of Arabi's works, then lift it off by means of the crane and fight it from the ground, leaving the train free to advance or retire. This was done at Mex for trial, and gave very fair results, but the process of mounting and dismounting entailing so much extra work under fire, it was decided to try the experiment of firing the gun from the truck itself. A baulk of timber was bolted to the fore part of the truck for the pivoting bolt, and a racer was laid down in rear, the breeching was secured to bolts in front, and the training tackles to iron spurs projecting about two feet on each side of the truck. The gun was protected by a packing case for a 500 lb. mine filled with sand, and with an iron plate bent round it, placed under the breast of the gun, and the spaces at the sides filled up with sand-bags. The shells were in the hinder part and covered with a plank to prevent injury. Against the hinder part was an arm rack for the men's rifles, with places for a glass, spare vent piece, &c., directors and measuring lines for range finding, and semaphore flags. Telescope sights were improvised in the following manner: an ordinary 2-foot Ross' telescope was fitted with cross wires, and a batten with V pieces were fastened to the fore and rear sights. The telescope was placed in these, and the gun laid by it; the telescope was then removed before firing. Great difficulty was at first experienced in seeing accurately where the projectiles pitched, so a ladder twenty feet high was made which could be erected in the ammunition truck, from the top of which a look-out could be kept.

The gun thus mounted first went into action on the 5th of August, and the results obtained exceeded the most sanguine expectations. No straining was

9 Inch M.L.R. Gun mounted on a Railway Truck.

FIG 1.

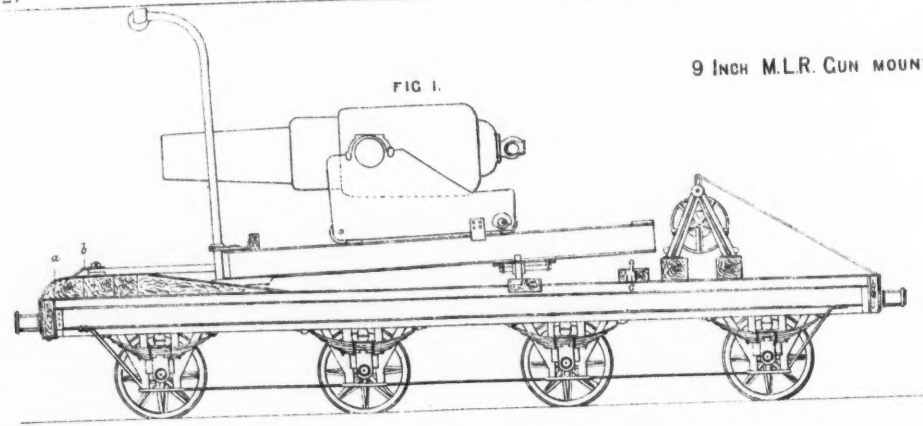


FIG 2.

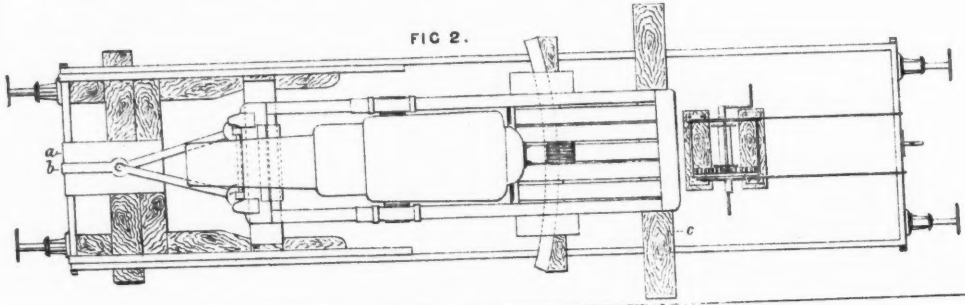


FIG 3.

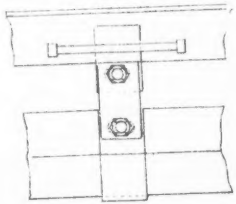
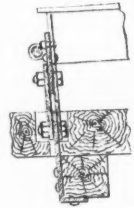


FIG 4.



SCALE OF FEET.

0 1 2 3 4 5

FIGS 3 AND 4 ON DOUBLE THE SCALE

Harrison & Sons, Lith. St. Martins Lane, W.C.

discovered in either the truck or rails, and the recoil of the truck was almost nothing. Several arrangements were tried as to the best way of making up the train, and eventually the following was decided upon—

1st truck, empty, so as to guard against the line being mined.
2nd truck, a Nordenfelt gun in front, spare rails for repairing the line.
3rd truck, spare rails, bowls, chairs, &c., for repairing the line.
4th truck, 40-pr. gun and crew.
5th truck, ammunition wagon. This was protected all round by thin iron, and the magazine was covered in front by a pile of short railway iron, a little higher than a powder-case. On each side was a baulk of timber, and on top a layer of rails, three or four of which were bolted down. The powder was in half metal-lined cases. This truck also contained fuzes, tin cups, tools, four cases of wet, and one of dry guncotton, Bickford's fuze, detonators, lantern and candles, slings for lifting the guns and carriage, bearers for the gun, a collapsible boat, stretchers, and arm racks for the covering party of twenty-eight men.
6th truck, protected with thin iron plates, carrying two Gatlings with their crews.
7th truck, two 9-prs. with their limbers, two 7-prs. and their crews.
8th truck, steam crane.
9th, engine, protected with railway iron laid horizontally along the boiler, $\frac{1}{4}$″ and $\frac{3}{4}$″ iron plates round the working parts, and sand-bags.
10th truck, protected by iron plates, carrying the covering party and with a Gatling in rear.
A reserve engine always followed, usually on the other line, and if necessary brought up another train with a battalion.

Later on another change was made, and the magazine truck was sent to the rear with the reserve engine, sufficient ammunition for ordinary use being carried on the gun truck.

At first, when the train went into action, it all remained under fire, but latterly the spare trucks and 40-pr. were pushed to the front, and the remainder retired out of action. Drag ropes were fitted to the 40-pr. truck and manned by the guns' crew under cover of the embankment, by which the range could be altered after each shot from the enemy, and so, as it were, dodge his shells.

The 40-pr. was manned by a gun's crew from H.M.S. "Hecla," under Lieutenant Davison, and the other guns by men from H.M.S. "Invincible," under Lieutenant Poore, the whole train being under the command of Commander Henderson ("Invincible").

When the 15-centimetre gun was mounted at Kafr-Dowar, it was found necessary to withdraw the train during the daytime, and it was only used after nightfall for patrolling the line. Lieutenant Davison then asked permission to mount a heavier gun; but as the only 7″ guns in the place were in position at Ramleh, and the 8″ guns were all destroyed, there were only some 9″ and 10″ guns available, and it was at first thought to be impracticable. Admiral Dowell, however, eventually gave him permission to try the experiment, and as far as could be judged, it proved a success. A truck, which had been constructed some time back to transport a 26-ton boiler from Alexandria to Suez was found in the store, and appropriated. It was longer than the ordinary trucks, and much stronger built, running on eight wheels close together and with especially constructed springs. He then went out to Mex with a spare truck, the steam crane and an engine, and with his gun's crew of twelve men he parbuckled a 9″ Armstrong M.L.R. gun from where it was lying on to the railway, a distance of 150 yards, hoisted it into the truck, and brought it in the same day. The next day a carriage, and the third day a slide were procured from the same place. The pivoting bolt

and racers were obtained from the same fort, by blowing up some of the *débris* and digging them out from where they were placed in position. As all these different parts belonged to different guns, some little difficulty was experienced in making them fit each other, but with the assistance of some carpenters from the "Invincible," and the workmen at the Gabari railway works, who were placed at his disposal by Mr. Carlisle, the manager, the gun was mounted. Three baulks of timber were placed across the fore part of the truck and bolted through the floor. A $\frac{3}{4}$" iron plate, 2' wide, was bent over these and bolted to the bottom of the truck, and in the centre of this platform the pivoting bolt was placed (Fig. 1*a*). As a further support another piece of $\frac{3}{4}$" iron, 4" wide, was fixed to the top of the bolt when the bars were in position, and also bolted under the carriage (Fig. 1*b*). The slide, which was of the land service pattern with high rollers, had to be cut down so as to bring the weight as low as possible. The rollers were taken off and the axletrees cut. An extempore rear-axle was made out of a bar of iron, and the rear-rollers of a 10" gun carriage were used as rear-slide rollers, the fore part of the slide working without rollers, on an iron skid plate. The rear-rollers were so far forward that the slide was very liable to tip up when the gun recoiled, in fact, several guns were disabled in the forts during the bombardment in this manner. An arrangement, was therefore, fitted to the fore part of the slide which prevented this, and, at the same time, allowed lateral motion to the slide for training (Figs. 3 and 4). In rear of the rear-slide rollers, a baulk of timber was placed, projecting about two feet on either side with bolts for the training tackles (Fig. 1*c*). When the gun was out and the training on, a wedge was driven in between this baulk and the rear of the slide, so as to take some of the weight of the gun on recoil off the rear axle, which was rather weak, and also to distribute the weight more evenly over the truck. In order to run the gun in, some sort of a purchase was necessary, and nothing could be found to answer the purpose better than the crab of the Moncrieff gun at Fort Ras-el-Tin.

The gun was then mounted by a crane, and everything worked satisfactorily. About 5° of training was obtained on either side, which in this case was sufficient to cover the principal works at Kafr-Dowar, particularly as there was a sharp bend in the line, and a very much larger arc could be covered by a judicious selection of points to fire from.

During the whole time that this gun was being mounted, the train with the 40-pr. and other guns went out every night to patrol the line, remaining out all night. This duty, going on at the same time as the men were employed mounting the 9" gun, made the work very harassing, but, notwithstanding this, the work was completed in eleven days.

After Kafr-Dowar was evacuated, and matters had quieted down somewhat, it was decided to try the gun in order to see what effect it would have on the truck and rails.

The gun was taken out to a clear part of the line outside the Gabari station, Lord Alcester, Vice-Admiral Sir W. M. Dowell, Captain Molyneux, Captain Wilson, and other Officers accompanying it to witness the trials.

The gun was pushed ahead with its magazine truck in rear of it to lessen the recoil, while the train retired about 500 yards. A scaling charge of 15 lbs. was first fired, then a 30 lb. charge with common shell, and then a 50 lb. charge with a Palliser shell at the extreme training the truck would admit of.

After each round the truck and rails were most carefully examined, but no sign of weakness could be discovered anywhere. The recoil of the trucks was about 20 or 30 feet, but that might be lessened by putting more weight in the magazine truck.

The trials were then discontinued as one of the telegraph wires was blown away. This accident, which would have been probably of no account if the gun was in action, caused the Admiral to give the order to cease firing, as the

telegraph was then in working order, and it was not deemed advisable to run the risk of doing further damage.

During the whole war the railway officials gave every assistance in their power, some of them going out with the train every time it went into action. The engineering staff, under Mr. Redmond, gave most valuable assistance in mounting the 9″ gun, reducing Lieutenant Davison's rough plans to scale, and working them out. In fact, without them the work could never have been done in the time. The enclosed diagram is from a sketch done by the draughtsmen at the Gabari works after the gun was mounted.

I am greatly indebted to Captain Wilson and Lieutenant Davison, who supplied me with the notes and information from which I have been able to compile this account. I have not gone into the details of any of the actions in which the train took part, as they do not come within the scope of this paper, but really form part of the general history of that part of the campaign which took place round Alexandria. I regret greatly that I have been unable to obtain any references to the employment of trains in this manner in previous wars, as they would have formed a most interesting addition to this paper. Although the 9″ gun was not put to the test of an action with the enemy, yet there can hardly be a doubt that it would have stood it well, and that in a future war a gun mounted on this principle, perhaps not as heavy a one as 9″, would be a very valuable addition to an army advancing along a line of railway.

NOTICE OF BOOK.

L'Année Maritime. Par Henri Durassier. Paris. Challamel Ainé. 1883. Pp. 424. Size 7¼″ × 5″ × 1¼″. Weight 1¼ lbs. Price 3 fr. 50 c.

This useful Review of the principal occurrences which take place during the year in the French and other Navies commends itself to all who wish to keep themselves informed on naval matters.

A special feature of the present volume is an interesting and detailed account of the French Expedition to Tunis in 1881, taken from official documents, and the conclusion of the history of the naval operations during the war between Chile and Peru.

Chapter II deals with organization and personnel, and gives a useful summary of the various Naval Budgets. Chapter III comprises a nominal list of the armoured ships of different Powers, with details of their gun power, armour, and speed. Under the heading of Artillery will be found a valuable study by Captain Rocard, of Coast Batteries. Recent torpedo experiments are noticed, and the volume closes with the text of the Law of 1881, relating to the French Mercantile Marine.